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THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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NOTICES.

Authors of papers printed in the Journal are hereby notified of the fact that, in accordance with Bye-law 43, they are entitled to receive not more than 50 gratuitous copies of their papers. Authors should state on their manuscripts their desire to have free copies, adding the number wished for. Unless the contrary be specially desired, this being stated on the manuscript, the reprints of an author's paper will not include the report of any discussion that may have arisen after the reading of the paper.

Members are hereby advised that the Subscription for 1885 falls due at the beginning of the year, and should be paid as soon afterwards as possible. The Council has decided that after January 1st, 1885, the 29th Bye-law will be strictly enforced, so that Members whose subscriptions are more than four months in arrear, will not continue to receive the Society's Journal.

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MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

February 2.—Mr. Boverton Redwood on "The Russian Petroleum Industry and Products therefrom."
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Monday, January 5th, 1885.

MR. DAVID HOWARD IN THE CHAIR.

REFERENCE was made to the decease of Sir Henry Roscoe's son at Magdalen College, Oxford, and a resolution of sympathy and condolence with Sir Henry and his family unanimously agreed to.

Mr. C. N. CRESSWELL (barrister-at-law), on rising to open the discussion on "The Proposed Rivers Pollution Bill," said: The subject of rivers pollution has attracted the attention of the civilized world, for the last quarter of a century, and during the last ten years has assumed such proportions that it has even received the attention of the legislature of the country. It had been attacked before in the scientific field, in 1868 by the Rivers Pollution Commission, and by a second Royal Commission in 1870, and the result of all these forces, commercial, agricultural, and scientific combined, was the enactment in 1876 of that which is known as the Rivers Pollution Prevention Act. The chief delinquents throughout this country who had brought about the state of things which led to this legislation, were the Boards of Health, who had been specially constituted to promote the health of the people, and to prevent the pollution of rivers. Amongst them, and most conspicuous by its dereliction of duty, was the great Metropolis itself, the emporium of commerce, and in the opinion of some the centre of civilization, at this moment in the throes of a revolution of public feeling which may perchance bring about some redress for a flagrant evil. Meanwhile the Metropolis always has been, and to this day is the greatest offender against those laws which are supposed to lie at the root of all sanitary progress and improvement. After the Act was passed I was invited by the Society of Arts to read a paper at one of its numerous health congresses, attended by representative men from all parts of the country; and in 1880 I was induced to become a member of the Executive Committee, under the Presidency of the Right Hon. James Stansfeld, M.P., himself connected with the industrial interests of this country. With him was arranged the programme of the conference, and *inter alia* a resolution insisting upon the necessity for considerable amendments in the Rivers Pollution Prevention Act of 1876. It had already been described in a paper read before that Society as a "piece of lame and impotent legislation," and I have never yet seen reason to change that opinion. Whereas it was designed for the purpose of preventing a great national evil, it has in fact—whether by defects of draughtsmanship, or the design of the promoters, I know not—contributed to legalize that which had hitherto been unlawful and preventible at common law; and it has given facilities to those who wished to transgress its provisions or disregard their own self-interests—opportunities which they never previously enjoyed. As a matter of fact the Act has seldom been put in force. It would be untrue to say that it has never been enforced, but in a return which was published at the instance of the Duke of Northumberland about twelve months ago, I find that during the six years in which that Act is supposed to have been in operation attempts have been made on 53 occasions only. Of these 53 proceedings there have been 24 orders to restrain pollution, which have been obtained, but have never been enforced at all. Twelve of them have been obtained at the instance of two particular authorities, the Over-Darwen and the Aire and Calder Navigation. Nineteen of them were obtained against Local Boards, Corporations, or Sanitary Authorities, to whom the duty of enforcing the Act

is committed by the Legislature. These cases have occurred only in 15 counties, so that there remain in Great Britain 37 counties in which no steps whatever have been taken to repress pollution, although in many of them it exists, and in its most aggravated forms, especially in Scotland. The ingenuity of lawyers and others soon detected loop-holes in the Act, and it may be convenient to mention one or more of them, since it is for the purpose of remedying those defects that the present bill, which is now before us, has been projected. The prime defect of the Act is that to which I have already alluded, viz., the want of proper machinery for carrying it into execution. Any person aggrieved was constrained to lay his case before the sanitary authorities, probably much greater delinquents than anyone else in the district. Naturally they were reluctant to put in force an Act which might be used very speedily against themselves. However in the event of that sanitary authority refusing the aid of their influence and resources (for it was to a great extent a question of resources), he could have recourse to the Local Government Board, and that department, if it were so minded, had the power of compelling the sanitary authority to put the Act in force. I know of a few cases in which that course has been attempted, and in each one the authority deemed the proceedings to be at least premature. Now, when any person, manufacturer, or sanitary authority had violated the Act, the first thing to be done was to serve him with legal notice. He, on the other hand, if well advised, anticipated the action of the authorities by giving also notice to the Local Government Board, asking that an inspector might come down and visit his premises. Of course during that period the Act is practically superseded, which was intended to give protection to the public from these and such like delinquencies. In every case you will find that something of the same sort has been done. For this reason the promoters of this bill have sought to curtail the dispensing power of the Local Government Board by leaving it to the Court to determine whether upon the report of the Local Government Inspector any extension of time should be given at all, and if opportunity for improvement be given, by limiting the period to six months. The second difficulty of the Act was in its definitions. In the enacting clause it had spoken continuously of liquid matters, and of solid matters—of liquid sewage matters, and of solid polluting matters; in fact they had used the words liquid and solid redundantly throughout, and had defined the word solid, negatively "It shall not include particles of matter in suspension in water." I well recollect hearing that illustrious chemist, the late Dr. Voelcker, say, in remarking on a paper I directed to this subject, that he knew of no more fertile source of pollution than matter held in suspension in water, and that if that were exempted from the operation of the statute, the statute was nugatory. He cited many instances. Some of us know a cause of alleged pollution in the south-west of England, viz., the washings from china clay works, which consist mainly of matter held in suspension in water. It cannot be asserted that the matter itself is polluting; at all events authorities differ on the subject; some contend that it is; but it is doubtful whether it could be held in law to be "polluting matter." There cannot, however, be a doubt that the continual deposition of mica, and other matters in suspension, is gradually silting up the rivers of West Devon and Cornwall, an evil which is becoming more aggravated every day. Nevertheless I see great difficulty in enforcing the Act against manufacturers of china clay in that district, and for this reason: There are clauses in the Act which prohibit you from putting anything in the nature of a solid into the bed of a river so as to cause obstruction to navigation. These waste waters have undoubtedly caused obstruction to navigation, and well-nigh choked the rivers in some parts of Cornwall, yet they cannot be treated as solids, because the Act declares that that which is held in suspension in water is not included in the words "solid matter." When the question was raised whether you could not bring to bear the polluting liquid clauses on that peculiar case the legal objection was taken, that as the liquid itself was pure, and the matter held in suspension was neither a solid nor polluting it would not come within the provisions of the statute, or any part of it. These definitions of liquid solids are expunged from the present bill now before the House. If public policy determine that the rivers are to be preserved from pollution, it is clear to all lawyers that it cannot be done under the Act of 1876. There are other defects, indeed it may be said that the Act bristles with them. I will, however, confine myself to those salient points which have been already under the cognizance of the courts. In the clauses which define an offence, the word "knowingly," a word well known to legal scholars, is continually used. It is difficult to conceive how a man can be said to be guilty of an offence if he did a thing unknowingly. As the Act is always construed strictly, that little superfluous word has again and again been utilized successfully to shield wrong-doers from the consequences of their acts, and it is of course excluded from this bill, which has been brought in by Mr. G. W. Hastings (one of the members for Worcestershire), Earl Percy, and Colonel Walrond. The latter represents a body of gentlemen who have felt themselves aggrieved by pollutions in South Devon. Earl Percy represents the northern counties, whilst Mr. Hastings was for years the president of the Social Science Association. Let us take the bill and notice—first, section 2, in which is defined in the simplest possible terms that which constitutes "an offence" under the Act. Now in 1876 for the first time it is declared to be an offence, and in the bill it is constituted an offence in one section, instead of three, and in unequivocal terms. The old Act is simplified in every direction, both as regards definition and procedure. Every person who puts or permits to fall into the river any solid matter which shall interfere with its due flow, (2nd) so "that it shall alter its bed, and (thirdly) so that it shall pollute its waters shall be guilty of an offence." One cannot imagine any solid matter, whether in suspension or not, that could harm a river, except in all or one of those three ways mentioned. It then proceeds to use the words "any liquid or solid sewage matter." In my opinion it would have been better to have written simply "any sewage matter." Surely it is the matter which causes the evil, and whether it be in a liquid or solid form seems to me to be immaterial. Then it goes on to say "any liquid containing matter poisonous, noxious, polluting, or injurious to animal life, from any manufactory, manufacturing process, mine, or place where any trade, business, or occupation is carried on." Hitherto there have been special clauses for mines, and as they were singularly ill drawn there have always been means found for evading them. The whole pith of the Act is in these sub-sections, and it is for the manufacturing industries to consider whether there be any valid objection to these clauses; if they pass, all the rest is mere procedure and clauses for carrying them into effect. But the machinery itself is improved. Neither the local sanitary authority nor the Local Government Board are necessary parties. It is simply whether

you are an aggrieved person, incorporated or unincorporated, and every possible known entity is, I believe, embraced within those words. They include the National Fishery Associations, who are not corporations in the ordinary sense of the term, friendly societies, town councils, or a board of health. In fact, everyone who feels aggrieved may come at once to the nearest Court and ask for redress, and it is in the power of the Court to make proper inquiries, ascertain the facts, inviting, if they will, scientific assistance, and then to adjudge a penalty not exceeding £50 a day. The Local Government Board, at the instance of the defendant, may send down an inspector to inquire; but the inspector's certificate is not, as before, conclusive evidence in the defendant's favour. Hitherto in every case certificates have been granted with more or less onerous conditions, and proceedings have been stayed. Now it is for the Court, in its discretion, by Clause 3, to do that which is just, providing they do not give an interval of more than six months during which the means of prevention may be improved. There is an appeal, of course, as there ought to be where any Court is invested with powers such as these. There was a Clause 6 in the Act of 1876, which I approach with some hesitation in an assembly such as this—inserted without doubt by representatives of the industrial interests in the House of Commons; and the qualifications intruded into that clause probably assisted the Act much in its passage through Parliament. This clause enacts that before giving consent to proceedings, the Local Government Board shall be satisfied that means are in fact available for preventing the alleged pollution, and that due regard shall in each particular case be had to the industrial interests of the district. Inasmuch as from the point of view of the manufacturers those industrial interests are supreme, whilst the National Fishery Associations and various agricultural interests are most probably of a different opinion, it is not within my province at the present juncture to express an opinion one way or the other; but inasmuch as from the point of view of industrial interests nothing could supersede the importance to the State of their existence, the result anticipated from the outset has invariably happened, and in construing this clause with regard to the interests of each industry the Department has been affected by political rather than sanitary considerations. As to Clause 7, I fail to see its importance. It seems to me whether you send polluting matters through an old channel, or a new one, it is polluting matter still, and the river suffers, and if it be desirable to amend that state of things it cannot be desirable to clog it with these complexities. Finally, as to Clause 9, which peculiarly affects the interests which you represent here to-night. It defines the so-called standards of purity, giving the minimum impurity which will be permitted; and affords a test of the measure and limit of pollution, defined, as the promoters think that it should be, by the Act itself. The definitions, if not word for word identical with those of the Rivers Pollution Commissioners', are based upon them. On the other hand, I have authority for saying that they were approved by no less an authority than Sir Lyon Playfair, and from the point of view of the representative of the University of Edinburgh, they represent the maximum of concession which can be given to the manufacturing industries of this country. Whether those industries by their representatives in Parliament will be content to accept that which the providential wisdom of great chemists will send them is another question; but I would submit to you that they are of grave importance to your interests, and that if you could by a committee appointed for the purpose, or by the machinery of your own association, express either approbation or disapprobation to those who are charged with the carrying of the bill through Parliament, I am convinced that every suggestion which you might make would be received with gratitude, and with a desire to conciliate the various interests which are so largely represented here this evening.

The Chairman said that they were much indebted to Mr. Cresswell for his able explanation of the proposed bill, but he could not help thinking that such purity as it sought could only be secured by the extinction of a large proportion of the industries of the country. The gravest fault of the bill was that it took no account of varying circumstances, but laid down rigid and impracticable standards. Another grievous fault was the proposal that any individual might gratify private malice by instituting a lawsuit at the public expense. After all, so-called sanitary authorities were the great offenders and not chemical manufacturers,

Mr. Newlands said there was one clause defining the standards of purity, which he thought required more consideration. Sub-section A of Clause 9 referred to any liquid which contained in suspension more than one part by weight of dry organic matter in 100,000 parts by weight of the liquid, but the great bulk of the rivers in the Kingdom below locks contained more than that as suspended mud. Then sub-section C prohibits the introduction of any liquid which shall exhibit by daylight a distinct colour when a stratum, one inch deep, is placed in a white porcelain or earthenware vessel. Now, a stratum of Thames water, taken at Victoria Docks, one inch deep, in a porcelain vessel, was anything but clear, and even the water used at Greenock, which was very pure in most respects, was highly coloured.

Mr. Johnson said: They ought to give an opinion upon the Bill in no uncertain tone. To Clause 5, he had three distinct objections: Firstly, the bill said: It would be the duty of the sanitary authority upon complaint of certain parties, to institute proceedings for offences against the Act; but Mr. Cresswell had told them that the sanitary authorities were the principal polluters of streams, and if they were the sole persons to prosecute offenders, they must, from necessity, prosecute themselves, which he thought was bad in English law. The next was: That the obligation to proceed on frivolous, vindictive, or malicious complaints, was unjust to the local authorities and far more so to the manufacturer against whom a frivolous complaint might be made, and in the event of the refusal of the sanitary authority to institute proceedings accordingly, complainant might make an *ex parte* application to the Court for permission to proceed at the expense of the sanitary authority. This was a great power for evil to place in the hands of any individual; but there was even a worse injustice than this, for Clause 3 said: That any person making default in complying with the requirements of an order shall pay to the person complaining a sum not exceeding £50 a day. Therefore there would be a strong motive to avaricious, needy and unprincipled persons to bring complaints. It seemed to him a great defect that the complainant in such cases should be empowered to move the Court for leave to institute proceedings at the expense of the sanitary authority, without giving notice; firstly, to the sanitary authority, and secondly, to the manufacturer, who it would be alleged had polluted the stream, and both should have leave to show cause why the permission of the Court should be withheld. The next clause he would notice was Clause 6 which

provided for an enquiry by the Local Government Board, but it did not state that the individual against whom an order had been obtained should have power to call in the Local Government Board and insist on an enquiry being made in his case. Mr. Cresswell said the words were, "If desirable in the opinion of the Local Government Board." Of course the Local Government Board could not express any desire or form any opinion unless they were put in motion. Mr. Johnson also pointed out that it did not provide at whose expense the enquiry should be made, and if all these legal proceedings were to be duplicated and reduplicated at the expense of the manufacturer, it would go far towards putting a stop to manufacturers altogether. Clause 8 Mr. Cresswell had stated that he did not consider important, and if so, it ought to be taken out of the bill, for according to it, every individual who used a house drain, communicating with a river by the sewer belonging to the sanitary authority for the district, if such drain were a new one, would come within the meaning of the Act and be liable to a penalty of £50. The next matter he would consider was the standards set forth in the interpretation clause. In the first place he objected to the term Standards of *Purity*, as they were not standards of purity at all; the proper term as he understood it should be *Standards of Maximum Impurity*. Then again, the wording was open to objection when the standards were stated to be "*any liquid*" when the word *water* alone was intended; and throughout the standards given the term "any liquid," having "more than" a certain quantity of the different polluting matters, the words *more than* should be left out, otherwise they would not be standards. In his (Mr. Johnson's) opinion at the present time some of the standards were not possible to be attained to by manufacturers in certain places, and on the other hand those referring to acidity and alkalinity were far in excess of anything which ought to be permitted in any stream employed subsequently as a source of water supply, or even in the interests of manufacturers lower down the stream. That in making standards of maximum impurity some principles should underlie the standards applicable to certain sections of a river, such as the use of the water subsequently for town water supply; and it would be manifestly a hardship on manufacturers, and quite unnecessary, that those whose works are situate on the tidal estuaries of rivers should be governed by the same standards, although the water, from contamination with sea water, never could be employed as a potable water; for instance, it would be monstrously unjust to impose the same set of standards on the tidal portion of the Thames below Teddington Lock, as ought to be insisted upon above it in the interests of the water supply of the Metropolis. He was of opinion that different standards should be arranged according to the particular requirements of the case; thus, he thought that if *all the solids* from sewage or otherwise were prevented in the tidal estuary of the Thames, it would remove the great cause of complaint which has called forth the late Royal Commission which has pronounced that portion of the river seriously polluted. He thought it would be far better if the onus of taking proceedings lay in the hands of the sanitary authority. It was worded all through "any liquid," but it was not clear whether it meant any liquid put into the river, or the water of the river after it was put in. Then, again, it said continually "any liquid which contained more than one part by weight," etc., but if it were more than one part it could not be a standard. Again, he thought it was putting a standard of maximum impurity on the shoulders of manufacturers which they would never be able to keep up to. If the bill was to be operative, the standards must be such that manufacturers could comply with them. He did not include the clause relating to arsenic, which he thought should be kept out entirely, but with regard to the question of acidity allowed to be put into a river, he had a great objection to such an immense amount as would be allowed. Clause *h* was any liquid possessing an acidity greater than that which is produced by adding two parts by weight of real muriatic acid to 1,000 parts of water. Now real muriatic acid was three times the strength of the strongest commercial fuming hydrochloric acid, and this would allow an acidity far too high. The same objection would apply to the case of caustic soda, which came in the next sentence. If standards were made, they ought to have some practical meaning. There should be standards of pollution, one for that portion of the river from which water was drawn, and the other for that which was polluted with sea water, or which might be called the tidal estuary of the river. Of course all solid matter ought to be kept out, and if that were done he did not think the rest would do much harm.

Mr. Ludwig Mond said he had followed this question with attention for many years, and was greatly puzzled to know what the country and the Legislature were aiming at, and he failed to see it even now. The word "pollution" was nowhere defined. If it said that anyone should offend against the Act who poisoned a river or fouled it so as to be injurious to animal life, that would be intelligible, but this was not so. There was among the definitions at the end of the Act a standard of purity which went very much further, but he did not see where this was referred to in any of the other clauses.

Mr. Cresswell said it was in Clause 2.

Mr. Ludwig Mond said if that was the only place, he took it that those who had hitherto spoken on the subject were entirely mistaken as to what the standard of purity meant. They did not refer to the liquor which left the works or went into any stream, but to the stream which was polluted. If it meant that the river was not to contain more than the standard allowed no one would object, and that was what he understood the Royal Commissioners on Rivers Pollution to mean.

Mr. Cresswell having read the last paragraph of Clause 2, said he would give an instance of what it was intended to prevent. A manufacturer poured the contents of his hydraulic mains into the Severn, and when indicted the defence set up was, if you analyze the River Severn half a mile below, you cannot find any trace of the pollution. It was monstrous to suppose that under such a defence a man should be allowed to pour the contents of a hydraulic main into a river; the intention of the Bill was that the stream poured into the river should be as pure as this standard, that if the stream contained a greater proportion of impurity than defined in A, B, C, or D you are open to complaint; on the other hand it is not a defence to say if you take the river water, and examine it after the waste liquid has flowed into it, it is less impure than any of those standards.

Mr. C. C. Hutchinson thought that it behoved them to ascertain that the machinery of any measure which proposed to deal with the subject should be of such a nature as not to prejudice manufacturing interests. He did not consider the bill before them of such a nature, and taking it altogether it was of a most rigid and unyielding character. He was unable to understand Clause 2, for it appeared to him that if an act of itself did not cause pollution a succession of such acts could not either. It seemed, however, that what was enacted was that although pollution might not be caused by any single material or person,

if two materials discharged into the stream separately, and by the same or different individuals, together produced a condition of things covered by one of the proposed standards of purity, such would be an offence, although taken separately no one of the acts contributing to the result infringed. This in many instances could be shown to be absurd. It was a pity that whilst they were drawing so largely in this bill upon the reports and recommendations of the Royal Commissioners on the pollution of rivers they neglected what was more valuable, in his opinion, than the enforcement of a set of arbitrary standards; he referred to the establishment of a Rivers Conservancy Board. This plan was proposed by Dr. Frankland and Mr. Chalmers Morton: it was infinitely more acceptable than the proposal made in the Act before them. This proposal virtually gave local boards and sanitary authorities the custody of streams, and, just as if they had not already more than enough to do, were constituted rivers conservators. He would ask those who had more experience of the working of local boards how such a measure would affect them. It had been pointed out by previous speakers that such boards would be the chief offenders, and would therefore be slow to put into operation a law which would recoil most powerfully upon themselves; that in itself was sufficient evidence of the impracticability of the proposed means of enforcement. Then, again, did they think that there were individuals sufficiently courageous to risk the costs of a lawsuit in order to compel an authority to exercise its functions; recent decisions in parallel cases, and the glorious uncertainty with which they seemed to be attended would deter any sensible person from embarking upon such a course, and, therefore, this Act would be just as much permissive, and would fail just as much as the Act in existence had failed. A central Conservancy Board would have none of these objections, because their sole functions would be to conserve the purity of the streams, and such an authority would discharge its duties both more efficiently and with more satisfaction to manufacturers, because they would have the guarantee that they had to deal with specific individuals and regulations, and would not be at the mercy of local boards, or the caprice of meddling individuals. Many of the standards of purity he thought so unreasonable as to be quite out of the question, *e.g.*, the proposition with regard to subsidence; that was perfectly unnecessary, for what did it matter how long a time was given so long as the other conditions were satisfied? With respect to the quantity of organic matter in solution, the effect of this standard would be to close at once nine out of every ten sewage works in the country, which were already satisfying the requirements of the Local Government Boards, for hardly one of them came up to the standard. The able report to which he had before referred shows that as far as sewage was concerned, the best chemical processes only removed from 28 to 50 per cent. of the organic carbon, and as sewage contained about 4·6 parts of organic carbon in 100,000 parts there would be still a quantity left behind which would considerably exceed that permitted by the Act. Again, the organic nitrogen in sewage equals about 2·25 parts per 100,000, and as the best chemical processes removed only from 36 to 65 per cent., as far as this was concerned the purification would not be nearly sufficient. It had been shown that so high results could only be obtained by intermittent filtration through prepared soil, and even then the results were not so concurrent as to comply continually with the Act; taking, however, that the best results of land treatment would be effectual, what were those manufacturers to do whose works were so situated that land could not be obtained? They had in many instances been so built round that there was hardly a foot of ground available; how then, if this Bill became law, could they adopt the means which was the only one enabling compliance with its conditions; they could not make use of the sewers or the rivers for getting rid of their waste waters, and, as a consequence, the effect would be that such factories would have to be closed. No provision seems to have been made for the part of a river or the position of a factory, and whether it was necessary as far as the river was concerned or not, all were to be compelled to purify up to the same high standard. Then, again, there was no elasticity in the matter, no provision made for exceptional occurrences which were entirely beyond control, *e.g.*, the overflow of storm waters from sewers, such exceptions had been pointed out as desirable by the Royal Commissioners when conditions similar to the one referred to would arise, when polluted materials could not possibly be dealt with, and must at such times be allowed to pass into the river. In conclusion, he had to say that in his opinion a measure so inelastic, so rigid, and so harsh, hardly appeared a fit one to inscribe upon the statute books, and its rigidity was of such a character as to defeat its own ends.

Mr. G. Bischof: With regard to certain clauses:—

I. 2 (*b*). appeared practically to exclude all liquids which at any time have been contaminated by sewage matter, as no process is known by which every trace of such matter can be abstracted. If my view be correct, very few liquids remain which are not objected to.

II. 8. should have been made quite clear, whether or not the penalty of £50 is to be for each day from the date of the first conviction.

III. 9 (*a*). We have no method for accurately determining organic matter in a water residue. This might be attempted in a rough and unreliable way by incineration, or more accurately by determining the constituents of organic matter. It should therefore be clearly stated what is meant by "dry organic matter."

The first three lines of this clause appear to exclude, without exception, any liquid which has not been subjected to rest for a period of at least six hours. If this be intended unreasonably—for what is the use of subsidence if a liquid should contain no matter in suspension?—the last six lines from "or which not" are futile, as these seem to indicate that liquids of a certain purity may pass without having been subjected to such subsidence.

IV. 9 (*h*). What is understood by "real" muriatic acid?

Dr. Percy Frankland said that he should like to make a few remarks concerning the standards of purity which had been so severely criticised by the previous speakers. He did not intend to defend them in this place, but he wished to point out some serious errors which had been made in reference to them. The great majority of the rivers in the country would uniformly comply with these standards, and even such polluted streams as the Irwell and the tidal Thames were frequently within the mark. Thus, from a large number of analyses which he had made of the tidal waters of the Thames, he could state that the suspended organic matter was generally under two parts per 100,000. No doubt it would be preferable if some elasticity could be given to these standards, for it was a very different thing to pour polluting matter into a river near its source, and to pour the same matter into the tidal portion of the stream; and again, the volume of the river should be taken into account. The clause relating to petroleum had

been introduced into the standards on account of the prejudicial influence exercised by this material in preventing the purification of foul liquids containing only a minute trace of it.

Mr. CRESSWELL, in reply, said he must admit that many of the criticisms on this bill were well deserved; but the object of bringing it before the Society was that its faults might be discovered and amended. With regard to the first paragraph, Dr. Percy Frankland had already pointed out that subsidence was not invariably required; but questions of grammar were of minor importance compared with that of the standards themselves. He had always understood that they were standards with which every manufacturer, if he would, might comply easily; they were certainly standards with which the upland waters of nearly every river in England complied. As the Society included some able men who were members of Parliament, it was certain that this question would not pass through committee without being properly ventilated. Mr. Johnson had spoken of a separate standard for each river. He recollected that Mr. Crookes, at the Hygienic Council, at Brussels, promulgated an idea which, at the time, much fascinated him, viz., that to lay down absolute standards of purity for all and every river was a mistake. Every river in the country had its own standard. If it were to be enacted that no one should be permitted to pass sewage or any other matter into it less pure than the river itself at the point of inflow, beginning from the head of the stream down to the sea, in the course of a very few years the river would become comparatively pure throughout its course. If the miller at the head of the stream were bound to comply with that provision, he would have his standard in the purity of the water from the rock. Below him would be the native purity of the rock plus A's, pollution, C would have A plus B, and so on, and as it were by a process of induction, you would eventually arrive at a pure stream. It would be ridiculous to impose a standard for the Thames at Gravesend such as was required but not yet acquired at Staines. He thought it would be better to expunge the whole of the standards, and enact that no person should be permitted to pass into any stream, whether through an old or new channel, anything which was less pure than the river itself at the point of junction. It would be a gradual process, and could only be done gradually. With respect to Clause 5, he was disposed to agree with Mr. Johnson that such a provision would not be entertained for a moment. Attention, however, had not been called to the fact that the complainant was bound to give security for costs, and would have to do in this as in every other case, take the burden of the law, and all its responsibilities, on his own shoulders; otherwise you cannot appeal to justice. Clause 8 seemed to have caused some amount of amusement, but on reading the first three lines the clause was as simple as possible. It was said by a species of the house-that-Jack-built-argument—"if you open a channel into a drain that opens into the sewer, and that sewer opens into the river, you are practically opening a new channel into the river. The object of this Act was to prevent house drains or sewers from being connected with any river. If drains and sewers were cut off from the rivers the new channels might open into the sewers, and the contents would go on to the land or into tanks where, by subsidence or precipitation, you could obtain an effluent fit for tidal streams, and, if required, where you could complement the process by deposition or filtration through prepared soil. The effluent would never enter the river at all until it was comparatively purified. He had heard it said by an eminent authority that if manufacturers would listen to the advice of their engineers and chemists it would be possible for them all to deal with their pollution, not only without loss and inconvenience, but in the majority of cases with profit to themselves. There were manufacturing processes which had been used for years, of which it had always been said that it was impossible to carry them on without polluting the rivers. Many in north and south earnestly believed that the manufacturing industries of this country involved in some measure the pollution of its rivers; and to them he would say that this bill had not assumed a definitive shape; there was elasticity in it as in any other bill before Parliament. If they would only bring the same acumen to bear upon it in committee as in that room, without doubt it would come out from the crucible a better bill than it was at present. With regard to the question raised by Mr. Hutchinson, that to place the conservancy of rivers into the hands of local boards was preposterous inasmuch as they had already much to do which they refused to do, he quite agreed with him. These boards were often composed of men who had learnt but one art in this world, viz., the art of doing nothing. In the conference, to which he had previously alluded, at the Society of Arts, he had brought forward a resolution which was unanimously adopted by a crowded meeting of surveyors, officers of health, etc., etc., in favour of the constitution of county boards, and after specifying several matters which should come under their control, concluded as follows: "That such county boards should be charged with the conservancy of rivers, including the prevention of floods, the storage of water, and the preservation of rivers from pollution."

The CHAIRMAN having proposed a vote of thanks to Mr. Cresswell for his exposition of the Bill, moved—"That this meeting of the London Section of the Society of Chemical Industry, being of opinion that the proposed 'Rivers Pollution Bill' is inadequate to the objects of its promoters, and injurious to the interests of manufacturers, recommends its early consideration by the Council of the Society, with a view to such action on its part as the interests of industrial chemistry may require."

Mr. TYRER seconded the motion, which was unanimously agreed to.

THE HYDRATION OF CELLULOSE.

BY C. F. CROSS AND E. J. BEVAN.

IN the historical development of chemical theory it frequently happens that doctrines are eclipsed or temporarily overthrown by the revelation of new groups of phenomena, with which, while at first sight they seem incompatible even to contradiction, they ultimately come to be reconciled, though not perhaps without modification. Thus, the term carbohydrate, given by chemists of a former generation to the group of compounds comprising the sugars and starches, implies an interpretation of their general empirical formula $C_nH_{2(n-m)}O_{(n-m)}$, which is now recognized to be crude as* it has been misleading. It would be impossible in the light of modern views to regard these compounds as hydrates of carbon in the more particular sense of the term; on

* We have seen in a modern text book the decomposition of sugar by sulphuric acid stated to be a resolution of its molecule into carbon and water, and advanced consequently as an evidence of the fitness of the term.

the other hand it has been lucidly shown by Baeyer,* in gathering up and more precisely expressing the latent views of chemists upon the peculiar relationships of this group, that they are susceptible of such profound and varied modifications by the loss and resumption of water molecules, *i.e.*, by dehydration and rehydration, and in this respect are so much more active than any other group of carbon compounds, that they are the hydrates of organic chemistry, *par excellence*. Certain of these transformations had been long known, as their nature had been empirically recognized; but to Baeyer belongs the merit of applying to their investigation the various types of hydration changes which have been established for the simpler and better known carbon compounds, more particularly of showing that upon such a basis the phenomena of the fermentation of the sugars admit of consequent and consistent chemical explanation. It is well known that this was a favourite tenet of Liebig's, and that his last researches were directed to its establishment in opposition to the teachings of Pasteur; his experiments and conclusions, however, suffered eclipse in the vast accession to our knowledge of the biological side of the phenomena, which came from the study of organized ferments. Now, however, that we see reason for regarding these as affording rather the exciting and directing than the sustaining cause of the molecular resolutions,—these resolutions being, moreover, as has long been recognized, not different in kind from those determined by what we may call purely chemical causes,—Liebig's experiments and his conclusions, modified by Baeyer's wider interpretations, may be re-introduced and allowed their full weight in the development of a chemical theory of fermentation. Into this controversy, however, we have no authority nor desire to enter; our object in this communication is to point out the bearings of the study of hydration changes upon certain of the many unexplained transformations of the celluloses. In the treatise cited above, Baeyer does not extend his discussion to the more complicated carbohydrates; and if we make the attempt to apply his conclusions to the better understanding of the hydration changes of the celluloses and the bodies allied to them, it can only be, we need scarcely say, in a very general way, with a clear recognition of the exceptionally complicated nature of the problems involved, and of our inability to do more than suggest a factor in their solution, which has hitherto been neglected.

It has, of course, long been recognized that hydration changes play a prominent part in the elaboration of cellulosic tissues; and apart from the more obvious dehydration which attends the transition from the plastic organization of actively growing parts to the condition of solidified tissues, it is certain that hydration changes of the more recondite order, probably also of a character even more elaborate than those which Baeyer has formulated, contribute largely to the result.

With regard to the former. It has doubtless struck every observer who has made a proximate analysis of a living or once living vegetable tissue, that the line of cellulose, as of lignose or woody fibre, has to be drawn in a very arbitrary manner; that in addition to the insoluble product which survives a succession of alternate treatments with a halogen or an acid, and alkaline solutions, there are present in the tissue a number of bodies of similar characteristics which disappear in course of the treatment as soluble derivatives. Many of these compounds come to be grouped together and dismissed under such terms as "extractive matters," which sufficiently indicate the empirical nature of the processes by which they are estimated. It is certainly a matter of great difficulty to determine the precise characteristics of such groups of compounds, as it is, therefore, to deal with them in our processes of analysis upon a more rational system. As a first guide to work in this direction, we may assume the existence of series of carbohydrates differentiated in point of hydration; and, therefore, of the presence in a growing tissue of transitional links of the chain connecting the celluloses with the simpler carbohydrates. These bodies are probably celluloses in every respect but the "condensation," which characterizes the insoluble and better known forms. In the course of certain investigations which we had the pleasure of conducting for Sir J. B. Lawes and Dr. J. H. Gilbert, we had ample opportunity of confirming these views by experimental verification. Adopting the hydration hypothesis, we tried the effect of the simplest process of dehydration of the tissue, viz., exposure to the action of alcohol at ordinary temperatures for some days.† The effect of this upon the cellulose of the tissue was manifested, though, of course, but imperfectly, by the increased yield of insoluble cellulose, resulting from the ordinary method of isolation; alternate treatment with chlorine and weak alkaline solutions. This is shown by the following numbers :—

(A) Samples of mixed herbage from grass land, made into hay. Cellulose percentage—

	(α) Isolated directly.	(β) Isolated after Alcohol treatment.	Difference.
Specimen (*a*)	31·4	34·6	3·2
„ (*b*) 1 crop.	24·3	27·1	2·8
„ (*b*) 2 „	30 0	31·6	1·8
„ (*c*) 1 „	24·5	29·7	5·2
„ (*c*) 2 „	23·3	27·0	3·7

(B) Specimens of growing (green) crops, treated immediately after cutting—

	(α) Directly.	(β) After Alcohol treatment.	Difference.
Triticum pungens	21·7	26·4	4·7
Oats, Leaves	28·2	35·4	7·2
„ Stems	39·5	34·5	5·0
Clover Stems	24·0	29·5	5·5

The treatment with alcohol consisted in leaving the specimens in contact with strong spirit for 14 days, fresh alcohol being substituted once or twice.

We have made similar determinations in specimens of ensilage, which we had the opportunity of investigating for Mr. G. Fry, and with similar results. Thus, in a sample of grass silage we obtained as the mean of two concordant determinations, 34·2 per cent. cellulose by direct experiment; 44 per cent. after treatment with alcohol. These numbers and results need confirmation and extension by further investigation, for which at least they indicate a useful direction. The value of cellulose and lignose as food stuffs to the herbivora has been a subject of considerable controversy. Should it be proved that the substances to which these terms are applied are simply members of series which graduate into soluble carbohydrates, their digestibility or otherwise will be shown to be bound up with their condition of hydration. Certainly the subject is worthy of the attention of all those who are engaged in investigating the food value of agricultural produce, and the influence upon it of the various methods of storage and preparation.

The fully elaborated celluloses, on the other hand, such as the isolated plant fibres in the condition in which they are applied to their various uses in the arts, necessarily require a more severe treatment to

* Ueber die Wasser-Entziehung und ihre Bedeutung für das Pflanzenleben und die Gährung. Berl. Ber. 363 (1870).

† Mere drying is attended with similar results. H. Müller (Unpublished Observations). Cf. *Jour. Chem. Soc.* Jan. 1885. p. 81.

bring about hydration changes. The investigation of these changes is not merely of technological interest, but must also contribute to the solution of the problems of the chemical constitution of their constituents. Assuming that in these transformations all the well-known types of hydration are represented as well perhaps as others not yet investigated, we may proceed to inquire into the degree of conformity of experience with this as compared with other explanations which have been advanced.

* It is especially important to bear in mind in this enquiry two of the known types of hydration which are perhaps the most remarkable, viz: (1) That which without altering the number or kind of atoms in a molecule effects their rearrangement as the result of dehydration followed by a rehydration which, taking a different course from that which the dehydration might be supposed to prepare for it, produces therefore an isomeride of the original. (2) That which, being of the same character as (1), effects a resolution of the molecule, the sum of atoms remaining unchanged. These changes may be simple or multiple. In the latter case resolution frequently results from the accumulation of oxygen by successive migrations to a centre within the molecule. It must be also remembered that these changes consisting of a series of dehydrations and rehydrations, with their attendant rearrangements and resolutions, may take place simultaneously in a system of similar molecules the surrounding physical conditions remaining unchanged.

The consideration of these probable factors of the transformations of cellulose reveals, and at the same time in some measure defines, the complications of the problems which they present.

Some of these we may now proceed to consider, taking first the typical or cotton cellulose. This cellulose is extremely inert, and requires comparatively severe treatment to bring about transformations involving the exchange of water molecules. With regard to the simplest determining cause—heat—the recent experiments of Scheurer and Grosseteste† have proved that the effect of heat upon the fibre becomes suddenly marked at 160°, whether heated in dry air or in contact with water, which point, therefore, is regarded by these observers as the "critical" temperature of dehydration of cotton cellulose. The action is suddenly marked in point of temperature only, not in regard to time; it required a lengthened exposure to this temperature to bring about the structural disintegration adopted by these authors as the measure of molecular charge, and exposure to the temperature of 150° for the same period effected no appreciable change. The identity of the results obtained in air and water eliminates the influence of oxygen as a factor of the molecular change, and reduces it to one of simple dehydration. The most obvious feature of the transformation is as before observed the structural disintegration of the fibre; this result we may provisionally regard as a criterion of dehydration, proceeding to confirm its adoption by the investigation of other instances of action which, reasoning from all analogy, are dehydrating. Concentrated hydrochloric acid rapidly disintegrates cotton when placed in contact with it at ordinary temperatures; the greater portion is converted into a friable modification having properties which identify it with Girard's hydrocellulose‡, at the same time a portion is converted into soluble derivatives of the dextrin type. The difference between the weight of the insoluble product and the original cellulose we have found to be 7-10 per cent. The formula which Girard assigns to hydrocellulose is $2C_6H_{10}O_5.H_2O$, and he supposes it to be formed from cellulose by a process of hydration. On the other hand, the conditions under which he states that it is formed—he particularizes exposure to sulphuric acid of 45° B. in the cold, or to boiling dilute acids—are of a dehydrating or condensing tendency; and further, such a hydration of the cellulose molecule remaining otherwise intact involves a gain in weight of some 5 per cent.; whereas, we have, in the case in question, always observed a loss. The only consistent inference from these facts is that the production of a cellulose hydrate under the circumstances and conditions we have described, is preceded by a dehydration and condensation of the cellulose; that the hydration therefore is not of a simple character, but results from a molecular rearrangement. The doubts which have been cast upon Girard's interpretations of the phenomenon§ show first, the necessity of a clearer appreciation of the possible complications of cellulose hydration, and secondly, the importance of carrying out all investigations of the transformations of cellulose on the basis of a strictly statistical study. The action of sulphuric acid in its more concentrated forms is to resolve the cellulose in various ways, according to the duration of contact; parchment paper, amyloid and dextrin, represent the products corresponding with varying durations. As all these products are obtained only after a subsequent dilution of the acid, it has never been shown what is the condition of the products of the original action of the acid. The concentrated acid might be supposed to combine with the cellulosic C-nuclei after the manner of its combination with aromatic groups, acting, *i.e.*, as $SO_3H.OH$, forming sulphonated compounds of little stability, which are decomposed by water and simultaneously hydrated. Such a reaction would involve an oxidation of the carbon nucleus, and of this it would be as difficult to bring direct proof as it would be to show that the hydrated monoxide of a dyad metal is correctly written $M\begin{matrix}\diagup OH\\ \diagdown OH\end{matrix}$. Indirectly, we have evidence of the disturbance of the oxygen equilibrium of the cellulose in the presence in the insoluble product (parchment paper) of active aldehydic groups, such as cause it to react with phenyl hydrazine, to reduce Fehling's solution, and to behave much in the same way towards reagents as Witz's oxidised cotton (*loc. cit.*), and also in regard to the increased manifestation of these properties with age.

It is worthy of mention here, that the reaction of sulphuric acid on heating with the pseudo carbons,¶ by which these are oxidised and sulphurous acid evolved, is a reaction of the acid with condensed cellulosic derivatives, the occurrence of which increases the probability of its taking place as a transitional phase of the reaction with other members of the cellulosic series, and under less extreme conditions.

The subject is one that requires revision, and we are engaged in the reinvestigation of several points here touched upon.

The action of alkaline solutions upon cotton is very slight unless they are applied in a concentrated form, or the temperature be raised very much above the boiling point. Under these circumstances the cellulose undergoes a modification which is, as regards physical properties, the very antithesis of the disintegration produced by acids, the products having a gelatinous character resembling the colloidhydrates of the inorganic oxides. This hydration of the

* For the full discussion of these Hydration Types, *vide* Baeyer's original paper or the translation by Dr. Armstrong, in the Jour. Chem. Soc. [2] 9, 331.

† Bull. Soc. Ind. Mulhouse, 1883. 62-85. This paper contains matter of the greatest interest for the bleacher and printer, notably an investigation of the effect of the singeing process upon calicoes.

‡ Compt. Rend, 81, 1105.

§ Witz. Bull. Soc. Ind. Rouen, 10,416, 11,169.
E. Fischer. Berl. Ber. 17-572.

¶ Phil. Mag. (5), 13, 325.

cellulose appears to be of the simplest character and, provided oxidising influences are excluded, to be unattended by any resolution of the cellulose molecule. The dissolution of the cellulose by the Schweitzer reagent we may regard as an extreme case of such hydration. It has not been attempted to decide what is the particular relationship of the ammonio-hydroxide to the cellulose molecule which may be regarded as the determining cause of the reaction; suffice it for this discussion to recall the evidence of its simplicity, viz., the ease with which the cellulose may be recovered, the completeness of the recovery, and the identity in regard to chemical properties of the reprecipitated with the original cellulose.

We pass on to consider the question of the hydration changes of cellulose produced by the action of dilute acid and alkaline solutions with the condition of oxidation super-added. Of the former we may instance nitric acid. In studying the reaction of cellulose with the dilute acid (60 per cent.) at 80 to 100°, we distinguished a preliminary stage in which the cotton was disintegrated (converted into hydrocellulose ?), followed by the oxidising action, the course of which was evidenced by the nitrous fumes in the vessel; this oxidation was a very gradual process at the temperature and with the concentration of acid employed; lastly, we observed the well-marked combination of the insoluble product, oxycellulose (β), with water on subsequently washing. We further observed in the statistical study of the decomposition that it proceeded to a limit which was reached when from 60 to 70 per cent. of the cellulose had been oxidised away. The most characteristic features of this decomposition are the absence of intermediate products, the comparatively small differences in composition of the cellulose oxyderivative $NoC_{18}H_{26}O_{16}$ (C43,4; H5,2) from the original cellulose $NoC_{18}H_{30}O_{15}$ (C 44,4; H 6,1), their general similarity in properties but particular differences in regard to capability of colloid hydration and of being attacked by dilute nitric acid. Reviewing these facts we infer that the primary action of the acid, which is oxyhydrolytic, is complicated because antagonised by subsidiary results in which the peculiar characteristics of the cellulose molecule in relation to hydration are manifested; and that the cellulosic product is the resultant of the dehydrating and hydrolytic actions which are brought into play. It should also be borne in mind that a mass of cellulose is not to be regarded as homogeneous, but as the researches of Crum have shown,* chemically as well as structurally differentiated, the variations brought to light being moreover of such a kind as are consistently explained by reference to hydration changes. Such differences obviously influence more particularly tho relationship of the cellulose to hydrolytic agents, and are doubtless operative in the decomposition in question.

The oxidation of cellulose in presence of alkalis is of a progressive nature, giving rise to an extended series of intermediate compounds. The products of the action of an alkaline solution of permanganate are acid bodies having the characteristics of the pectic group. We obtained as a first limit of the decomposition, *i.e.*, when all the cellulose (employed in the form of the gelatinous hydrate reprecipitated from the Schweitzer solution) had disappeared in solution, a highly acid body or mixture of bodies having the empirical composition $C_{19}H_{18}O_{22}$ (C = 38,1, H = 3,1) very hygroscopic and reducing Fehling's solution on gently warming.†

‡H. Müller obtained products which appear from his description to be of a similar nature, by the action of strong solutions of the hypochlorites upon cellulose. The series of oxidised derivatives of cellulose described by Witz in his recent interesting memoirs§ are obtained for the most part by oxidation under the condition of a feebly basic or acid reaction, and influences which in themselves are not usually productive of hydration changes. That such take place, however, as a consequence of the oxidation, we infer from the structural disintegration of the fibre. This is immediate if the oxidation be severe, but under less extreme conditions the oxidation appears rather to open up a path for oxyhydration changes which proceed after the removal of the cellulose from the oxidising influence. The inference as to the occurrence of such hydration changes is necessary to account for the profound modification of the fibre, and the marked increase in the chemical activity of the cellulosic product, which accompanies a scarcely appreciable change in empirical, *i.e.*, aggregate composition. The chief feature of these oxy-celluloses (α) is the presence of active acid and aldehydic groups, and they occupy a position intermediate between the series of compounds described above, corresponding indeed with the conditions of their formation.

If we turn now from cotton cellulose to other substances of similar composition to which the term has been applied, and chiefly to those forms which are more familiar to us by reason of their technological applications, we find that they differ from the former or typical cellulose in chemical as well as morphological characteristics. So far as they have been investigated these differences do not appear of much moment in comparison with the broader features of resemblance, but they may be taken as indications of greater differences which future research will doubtless bring to light. We have frequently alluded to the celluloses isolated from lignified tissues by processes of chemical resolution, and to the fact that they more nearly resemble in composition and properties the oxycelluloses. The greater activity of these celluloses is seen in their affinities for colouring matters, in their reduction of cupric oxide (Fehling's solution) and in their reactions with the aromatic bases. Of these we have found phenylhydrazine¶ especially useful in revealing differences which might otherwise be overlooked; celluloses when boiled with an aqueous solution of its salts are coloured more or less deeply (yellow) in proportion to their synthetic activity. A solution of aniline sulphate at the boiling temperature, gives a very striking reaction with certain celluloses, notably those isolated from esparto and straw by the ordinary process of digesting with a solution of caustic soda at an elevated temperature. These are dyed a rose-pink of varying intensity, a reaction which we have found useful in detecting their presence in white paper.

Celluloses which are isolated from combination by means of processes of hydrolysis, are doubtless themselves modified by hydration changes induced by the conditions under which they are separated, and the reactions in question may result from modifications in constitution, *i.e.* partial resolution, which accompany these changes. So little however do we know of these compounds, that we cannot do more than adopt the suggestions of these observations as a guide to future investigations.

A distinctive feature of these various celluloses, which is referable to their varying capacities for colloid hydration is the varying degree of softness

* Chem. Soc. J., 16, 1 and 401. See also Bowman's Structure, of the Cotton Fibre, Manchester, 1881.
† J. Soc. C. I., 3,209.
‡ Pflanzenfaser, p. 15.
§ Bull. Soc. Ind., Rouen, 10, 416; 11, 169. *J. Soc. Chem. Ind.* 3,209.
¶ Berl. Ber. 1,7572.

and elasticity which they possess after drying from the moist state by the aid of heat*. The fibrous celluloses of the arts in their normal state are not susceptible of such changes as affect these properties, except under severe treatment, but when imperfectly elaborated these celluloses, as others in their normal condition, are very easily converted into hydrated gelatinous modifications, notably under the action of alkaline solutions. The presence of such hydrates and their effect upon a cellulosic fibre is demonstrated by a comparative treatment with alcohol previously to drying, this method of dehydration preventing in a great measure the peculiar aggregation of the fibres which otherwise attends the drying from water. The conversion of cellulose into such hydrates is to be regarded technologically as a degradation, and it will be found that the commercial value of a cellulose is *cæteris paribus*, in the inverse ratio of its tendencies in this direction. The influence of alcohol upon celluloses of this character has been dealt with in the earlier part of this paper, and from the results there detailed we may infer that their conversion into soluble derivatives by the action of alkaline solutions is correlated with the tendency to colloid hydration, which we may regard as a transitional stage. These points are of especial technical importance at a time when so many new processes for the preparation of cellulose are claiming the attention of manufacturers, and a careful consideration of their bearings will enable us to form a better appreciation of both processes and products, than on the assumption that a given raw material will yield the same cellulose whatever the process by which it is isolated.

We pass on to a brief consideration of these processes in relation to the general question of the hydration of the celluloses. As a necessary preliminary we devote a short space to the examination of the raw material (for the most part lignified cellulose or lignose) from the point of view from which we have discussed the celluloses. We have already shown that the action of hydrolytic agents upon the compound celluloses of the lignose class is, in the first instance, to resolve them partially into soluble derivatives which retain all the essential chemical features of the original. To illustrate this point afresh we may cite some recent experimental results.

A specimen of jute was boiled 12 hours with dilute sulphuric acid (7/), a stream of SO_2 being continuously passed through the boiling solution. The insoluble residue was a brownish red powder, the fibre having undergone complete disintegration, and when dried and weighed was found to amount to 64 per cent. of the original fibre. A comparison in regard to chemical composition gave the following results:—

	Residue.		Original fibre.
Carbon percentage..............	47·5	....	47·3
Cellulose (isolated by Cl-method)	78·0	....	76·5
Carbon percentage of cellulose..	43·3	....	43·5

Nothwithstanding, therefore, that a large proportion of the fibre constituents yielded to the hydrolytic action of the acids, becoming converted into soluble modifications, there had been no sensible change in composition. This result confirms many that we had previously obtained; in this case, however, the hydrolysis had proceeded farther in consequence of being aided by the sulphurous acid, and the result is therefore the more striking. In this hydrolysis a considerable quantity of furfural is liberated. We have endeavoured to determine the quantity formed by taking advantage of its colour reaction with aniline salts.† In this case we employed hydrochloric acid only, diluted with twice its volume of water. The quantity estimated was 11 per cent. of the weight of the fibre; with hydrochloric acid of 10 per cent. the quantity was 7·5 per cent., and with sulphuric acid of 10 per cent. 11·2 per cent. of the fibre.‡ The stony concretions of pears, Erdmann's glycodrupose which we have shown to have a similar constitution, yielded under the same treatment a quantity of the aldehyde estimated at 18·6 per cent. of the original substance. It is unnecessary to say that these numbers are to be regarded only as approximations.

It is these hydration changes of lignose and its allies which in our estimation, throw doubt upon the "incrustation" theory of lignification. The incrustation of fibres is of course on the one hand, a morphological fact, but to account for it by a chemical incrustation, is a pure hypothesis resting upon an equally hypothetical analogy. As we have frequently pointed out, the reactions of the jute fibre (bastose) are not those of a crude admixture of a cellulose, as usually understood, with non-cellulose constituents which, while imparting to it its peculiar features of difference from a simple cellulose fibre, overlie it in such a way as to mask its reactions; but are of such a nature as to indicate that it is at least chemically homogeneous, in the same sense that the true celluloses are taken to be. Such a theory of the constitution of bastose does not exclude any more than in the case of the celluloses themselves, the differentiation in point of hydration which undoubtedly marks the natural fibre; indeed its relations to the question of hydration, as here discussed, present the closest similarity to those of the simple celluloses, of which they are in many respects typical. The hydration changes determined by reagents are similar in that they do not affect the essential chemical features of the original; but under conditions which disturb the balance of oxidation of the molecule, a fundamental resolution occurs, into products which are derivatives of the constituents of the original fibre, and from which, making due allowance for the changes accompanying the resolution, we may infer its probable constitution. So we take bastose and its allies to be compound celluloses, resembling the simpler celluloses to the extent that such a qualification implies. Whether, or rather, in what way genetically connected is a problem for future solution, to which the investigation of hydration changes may be expected to contribute.

We may now turn to a brief consideration of the processes by which these lignocelluloses are treated for the isolation of a paper-maker's cellulose. Having regard to our present point of view we shall treat them in the order of the temperature they employ as the condition the most obviously affecting the hydration changes.

(1) *Temperature below* 100°.—There is only one such process at present known, which is practically available, and that is the treatment with a concentrated sulphurous acid in closed vessels, at 80° to 90°, and at the corresponding pressures§ (SO_2) of 4 to 5 atm. From the study of this process with the kind assistance of the inventor, we conclude that the action of the acid is purely hydrolytic; this is to be inferred from the examination of the products and from the perfect recovery of the sulphurous acid after the treatment. In regard to the intermediate stages it is highly probable that the acid fulfils a second function, and that its hydrolytic action is so much more complete than that of other aqueous acids by reason of its promoting oxygen-exchanges, and consequent re-arrangements. In its last results, however, these

* J. Chem. Soc., Jan. 1883.
† V. Meyer., Berl. Ber. 11,1870.
‡ Annalen 138,1, 5 Suppl., 223.
§ Patented by Raoul Pictet. German Pat. 1883, 26,331; cf. Eng. Pat. 2,924, 1866.

probable changes do not appear, and having regard to these, its action is one of the simplest hydrolysis. The resolution of the lignocelluloses by dilute nitric acid at 60° to 80° is apparently simpler, but the hydration and other changes involved are in reality much more complicated, as may be inferred from the products and from the oxidation which accompanies their separation. The same considerations apply to Schulze's method of isolating cellulose by prolonged digestion of these lignocelluloses at still lower temperatures with dilute nitric acid, with addition of potassium chlorate. Both these oxyhydrolytic processes are, however, rather of laboratory than technical interest ; and of less theoretical interest than the sulphurous acid process, because more complicated. This latter is then the simplest case of the hydrolytic resolution of a lignocellulose into an insoluble cellulose, and soluble derivatives of the so-called encrusting substances. As already explained, those re-agents which are hydrolytic only, *i.e.*, which are incapable of determining oxygen exchanges, do not resolve these compounds, but rather dissolve in virtue of hydration changes.

(*b*) *Temperatures above* 100°.—The lignocelluloses, as indeed the celluloses themselves, are considerably attacked by exposure to water at 160 to 170°. The reaction we may suppose in the first instance to be one of dehydration, but the products of the consequent resolution having a hydrolytic action, this new and opposite condition is introduced, and the brown coloured disintegrated product may be regarded as the resultant of these actions. The introduction of certain normal but unstable salts for the purpose of combining with the soluble products of resolution, simplifies the decomposition, and allowing it at the same time to proceed much farther the resolution of the lignocellulose is more complete. Of such salts the most important are the sulphites of the alkalis and alkaline earths. By the presence of these the additional complication which results from oxidation is likewise prevented. That their function is an indirect one, and that they do not materially contribute to the hydrolytic influences, is to be inferred from the fact that they do not affect the physical conditions necessary to be employed. As regards their mode of combination with the products, it is probable that they become split up into base and acid salts, the former going to the OH groups, the latter to the aldehydic products of resolution. Such a division corresponds to that of the most important processes of the paper-maker into (*a*) the older alkaline treatment and (*b*) the recently developed acid-sulphite processes. These we have contrasted and more fully discussed on previous occasions ;* here we may simply indicate their leading features in regard to the hydration changes involved. The temperature required for these resolutions is lower than for the preceding processes, and the cause is to be found in the additional hydrolytic action of the free alkali and acid respectively. The tendencies to a reversal of the hydrolysis by dehydration of the dissolved products are met in both cases by their combination with the reagent employed ; the complications which result from oxidation are on the other hand prevented in the sulphite treatment, but intensified in the alkali processes, as the comparative study of the by-products of the two processes sufficiently shows. Of the differences between the isolated celluloses we have already spoken. Future investigation will establish these more clearly.

We trust that this brief and imperfect discussion of a complicated subject will contribute to the elucidation of the problems of cellulose chemistry.

* *J. Soc. Arts*, 31. 220. Reports (Essays) I. Forestry Exhibition, Edinburgh, 1881.

COMPOSITION AND MANURIAL VALUE OF FILTER PRESSED SEWAGE SLUDGE.

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The application of the filter press to the treatment of sewage is, perhaps, the most important step that has been taken during the last few years towards the complete solution of this difficult problem. It is admitted on all hands that whatever changes may take place in the mode of collection and disposal of excreta in the near future, there will, for a long time, remain to be disposed of in nearly all our populous towns an enormous quantity of "sewage" similar to that which flows through the main sewers of the metropolitan area—human excreta, diluted to an almost worthless point with household waste water and with the storm water and road dirt conveyed into it by the street gutters. This material is so dilute, that irrigation, in one form or another, has seemed for a long time to offer the only chance of utilizing it with any prospect of profit. In a few instances irrigation has apparently had this desirable result, but in perhaps the majority of cases in which it has been tried it has proved more or less of a dismal failure. I think I may go as far as to say that the irrigation of ordinary arable land with crude sewage has never proved successful from the double point of view of avoiding a nuisance, and of disposing of the sewage at a commercial profit. There are, of course, several causes for this disappointing want of success, but the chief amongst them is the inability of arable soil to deal with a continuous supply of sewage without great deterioration in its purifying and aerating properties, so that at last it becomes "sewage sick," and inefficient as a purifying agent. This is not completely remedied by "intermittent" filtration or irrigation, for the land which has been often covered with crude sewage never recovers, even by rest, its original efficacy. The commonly accepted, and I believe the true explanation, of this is, that the slimy suspended matter of the sewage gradually chokes the pores of the soil, forming a deposit impervious to air, and thus preventing the aeration essential to nitrification, and on the other hand encouraging putrefactive fermentations. The removal of this suspended matter from the sewage, however, renders irrigation much more practicable ; with a clear effluent and a porous soil the nitrifying power brought into play is enormous, and a moderate area of soil, whether grass land or arable, can deal with large and almost continuous doses of sewage water.

Nitrification, as has been shown by the experiments of Mr. Warington, and by my own (which were undertaken to confirm his results, and to extend them to the case of natural waters) is a process which varies enormously in rapidity according to the favourable or unfavourable nature of the conditions under which it takes place. It may proceed at an almost imperceptible rate for months, or it may be altogether in abeyance, when by a slight change in temperature, in the aeration or the reaction of the medium, or in other circumstances not fully ascertained, the process suddenly starts into vigorous activity, and completes its work in the course of a few days. Amongst the clogging or retarding conditions I find the absence of air and the presence of objectionable organic matter to be almost as important as a lowering of temperature. It will readily be understood then, that the removal of the suspended matter from sewage becomes equally desirable whether the effluent is to be used for irrigation, or is to be discharged in its partially purified condition into the nearest stream.

At Salisbury, for example, the sewage has hitherto been discharged in its crude state into the Avon, a river which has for a very long time been employed for the irrigation of the extensive water meadows which line its banks almost all the way from its source to the Hampshire coast. This river is about as favourably circumstanced as any in the kingdom for dealing with sewage directly discharged into it; and the extent of purification effected by the water meadows may be judged from the fact that a very short distance below the city there is no trace of sewage contamination in any form, and the water is perfectly pure, bright, wholesome and sparkling. Even here, however, the presence of the sludge is felt to be a difficulty, and the condition of the river having been objected to by the landowners immediately adjacent to the sewage outfall, it has been decided to precipitate the sludge by chemical means, to filter press it, and to discharge the purified effluent into the river as before. When this is done the water meadows below the city will still reap the benefit of the greater part of the fertilizing matter of the sewage, whilst no nuisance will be occasioned in the river even in the immediate vicinity of the sewage works. As regards other modes of dealing with the suspended matter of sewage, it is, I think, sufficient to remark that unless filter-pressed and quickly disposed of, sludge is even a greater nuisance when separated from sewage than when mixed with it. The slow drying up, for instance, of a deposit of wet sludge by simple exposure to the air is productive of nothing but odours of putrefaction, and the accumulation of a material concerning which people entertain but the sole desire to be as far away from it as possible.

Mr. C. C. Hutchinson, in a paper published in the February (1883) number of the Society's Journal, has given such a full description of the process of filter-pressing, and of the results obtained by its application to sewage sludge, that there is no need for me to enter into any detail on this part of the subject. The disposal of the filter-pressed sludge, however, is a matter which has not yet been brought to a successful issue, and as the number of towns and districts dealing with sewage by precipitation and filter-pressing is increasing rapidly, it becomes a question of great importance to find some means of utilizing the very large quantities of pressed sludge cake that are certain to be produced.

The sludge before pressing contains as much as 90 per cent. of water, and this is reduced by the filter-press in the course of a very short time to about 50 per cent., leaving the sludge in the form of compact circular cakes (somewhat resembling oil cakes) of brown or olive-green colour. The cakes in this condition contain ·6 to ·9 per cent. of nitrogen and over one per cent. of phosphoric acid, and should be of considerable manurial value. But no actual comparative trials of its value as a manure have, to my knowledge, been made, and in default of any recognised value conferred upon it by such means its sale at any price becomes a matter of difficulty.

In order to give, if possible, a definite agricultural value to the filter-pressed sludge, or at all events to obtain some knowledge of the conditions under which it may best be made available, I determined to make use of the facilities kindly afforded me by Professor Wrightson on the College of Agriculture Farm, to institute a series of comparative manuring trials of various samples of the sludge against farmyard manure and artificial fertilizers of known value.

By the kindness of Messrs. S. H. Johnson and Co., the filter-press manufacturers, of Stratford, I obtained, in February last, samples of sludge from three differently situated districts in which chemical precipitation of the sewage is combined with subsequent treatment of the precipitate in filter-presses. I received simultaneously half a ton of broken cakes of each sample, delivered in superphosphate bags of the usual size, and I will proceed to describe the appearance, mode of production, and composition of each sample, before detailing the arrangement and results of the experimental plots.

Coventry Sludge.—In this case the sewage of a manufacturing town is precipitated by the successive addition of sulphate of alumina, sulphate of iron, and milk of lime. As this treatment is succeeded by filtration of the effluent through land, and as the works are small compared with the quantity of material with which they have to deal, precipitation in the tanks is not so complete as it would otherwise be. The matter escaping collection in the tanks will be the lighter flocculent matter, and that requiring the addition of a larger quantity of the reagent for precipitation—in both cases rendering the precipitated sludge poorer in nitrogen. The town is a water-closeted one, although not altogether so, and the manufactures which have any effect on the sewage, are chiefly of the lighter textile kind, such as ribbons and tapes and other "Coventry" goods, thus contributing a fair amount of dyeing refuse. There is no "separate system" of collecting the surface water apart from the sewage, so that the sludge contains a proportion of road detritus varying with the rainfall. As the weather was fairly dry when my sample was collected the admixture from this source was not excessive. This sludge was received by me in a very wet condition. The cakes contained nearly 60 per cent. of water, and no doubt had not been submitted to pressure for a sufficient length of time on account of the filter-presses at Coventry having to deal with a much larger quantity of sewage daily than they were designed for. The bags in which the sludge was kept were quickly and completely rotted, and the exposed surfaces were covered with a thick white mould. The cakes of sludge became consolidated into one mass, cutting under the spade like clay, and emitting foul gases as the internal cavities were cut into. When weighed up for use in May it still contained 36¼ per cent. of water, and had to be put on the land in the form of soft clods too adhesive to be easily broken up by cultivation operations.

Leyton Sludge.—The sewage is treated in precisely the same manner as at Coventry, but the nature of the locality is entirely different. Leyton is a rural and suburban district with no manufactures of any kind contributing to sewage, so that the latter may be taken as wholly made up of the refuse and excreta from dwelling-houses and road drainage. For this reason the Leyton sludge would be expected to be more nitrogenous, and to possess a higher agricultural value than either of the other sludges, and doubtless this would be the case could we ensure similar conditions as regards the time and manner of collecting the three samples, and as regards the various accidental circumstances which affect the composition of particular batches of sewage. But of the actual samples which are the subject of the present paper, it is interesting to note that the Coventry and Leyton sludges differ principally in the percentage of water originally present, and in the amount lost by air drying in the bags during the interval from February to May. The Coventry sample was the wettest of the three, and the proportion of water it lost by air drying was least of the three. But the percentage composition of the *dry* Coventry sludge is identical, so far as important constituents are concerned, with that of the *dry* Leyton sludge, and both differ from the *dry* West Ham sludge in containing a much larger pro-

portion of road detritus, so that the West Ham sludge is decidedly richer than the other two in nitrogen and phosphoric acid—the two constituents of direct manurial value.

The cakes of Leyton sludge, as received by me direct from the presses, contained about 50 per cent. of water. This was reduced by air drying in the bags between February and May to 21 per cent. The bags were rotted to some extent, but the sludge remained soft and was almost friable, so that it could be reduced to a fairly fine state of division by ordinary farm implements and operations, and to this circumstance I attribute the fact that although not the richest sludge it gave the best crop of the three experimented with.

West Ham Sludge.—This is the result of precipitation by sulphate of alumina and milk of lime of the sewage of a large and thickly populated manufacturing district. The manufactures are of the most varied class, and some of them are of a very polluting character. The sewage is very foul and difficult to treat, but the precipitation is pretty complete. The pressed cakes of sludge had been kept sometime before being sent to me, so that they were partially air-dried, and contained about 30 per cent. water. In consequence of this the bags in which they were kept remained fairly intact in May, and the manure was then in a much drier condition than the other two samples, and contained only 15½ per cent. of water. On the other hand it had become so hard as to resist all attempts to reduce it to anything like a fine powder by means of the pick, shovel, or rake. It resembled, in fact, partially dried clods of a clay soil, and was in the same intractable state to cultivation. Nothing short of a mill would have sufficed to reduce it to a fit state for economical employment. To this cause I attribute the fact that although a much richer sludge than the other two, the crops yielded by the employment of an equal weight of it were not sensibly superior. The sludge also differed from the others in appearance, being grey or slate coloured, like a dark sample of superphosphate. But the principal difference lay in the fact that it contained a much smaller proportion of road detritus, being, I suppose, obtained from sewage collected at a period of less rainfall.

It is this admixture of road dirt which is the chief agent in reducing the manurial value of *dried* sewage sludge.

The "organic matter" of the three samples of sludge experimented with would have contained, in a dried and pure condition, 5·17 % of nitrogen in the Leyton sample, 5·20 % in the Coventry sample, and 4·51 % in the West Ham sample; but whereas the two former samples of dry sludge were diluted with 74 per cent. of mineral matter, consisting chiefly of road dirt, and the percentage of nitrogen was thereby reduced to 1·35 and 1·36 respectively, the *dry* West Ham sludge contained only 60 per cent. of mineral matter, and its percentage of nitrogen was 1·82.

The detailed analyses of the samples of sewage sludge employed are as follow:—

COMPOSITION OF DRIED COVENTRY SLUDGE.

Organic matter		26·11
Containing nitrogen	1·36	
Ash		—
Soluble in Acetic Acid.		
Carbonate of lime	39·07	
Phosphoric acid	0·05	
Oxide of iron, alumina, and soluble silica	1·11	
Potash	trace	
Soluble in Hydrochloric Acid.		
Phosphoric acid	2·38	
Oxide of iron, alumina, etc.	7·26	
Potash	0·30	
Insoluble.		
Sand and silicates	22·84	
	73·31	
Magnesia, sulphuric acid, sodium chlorine and loss	0·52	
		73·86
		100·00
Total P_2O_5	2·43	
Citrate soluble P_2O_5	1·37	

COMPOSITION OF THE COVENTRY AIR-DRIED SLUDGE AS USED ON THE PLOTS.

Water	36·23		
Organic and volatile matters	16·67	containing nitrogen	0·87
Ash	47·10	" P_2O_5	1·55
	100·00		

COMPOSITION OF DRIED LEYTON SLUDGE.

Organic matter		26·08
Containing nitrogen	1·35	
Ash		—
Soluble in Acetic Acid.		
Carbonate of lime	26·36	
Phosphoric acid	0·29	
Oxide of iron, alumina, and soluble silica	7·12	
Potash	trace	
Soluble in Hydrochloric Acid.		
Oxide of iron and alumina	7·79	
Phosphoric acid	1·75	
Potash	0·34	
Insoluble.		
Sand and silicates	26·21	
	70·16	
Magnesia, sulphuric acid, chlorine sodium and loss	3·76	
		73·92
		100·00
Total P_2O_5	2·04	
Citrate soluble P_2O_5	1·69	

COMPOSITION OF THE AIR-DRIED LEYTON SLUDGE AS USED ON THE PLOTS.

Water	21·16		
Organic and volatile matter	20·56	containing nitrogen	1·06
Ash	58·28	" P_2O_5	1·61
	100·00		

COMPOSITION OF WEST HAM DRIED SLUDGE.

Organic matter		40·32
Containing nitrogen	1·82	
Ash		—
Soluble in Acetic Acid.		
Carbonate of lime	23·72	
Phosphoric acid	0·38	
Oxide of iron, alumina and soluble silica	1·93	
Potash	trace	
Soluble in Hydrochloric Acid.		
Phosphoric acid	2·19	
Oxide of iron, alumina, etc.	8·09	
Potash	0·22	
Insoluble.		
Sand and silicates	18·30	
	54·83	
Magnesia, sulphuric acid, sodium chloride and loss	4·85	
		59·68
		100·00
Total P_2O	2·57	
Citrate soluble P_2O_5	1·21	

COMPOSITION OF THE WEST HAM AIR-DRIED SLUDGE AS USED ON THE PLOTS.

Water	15·43		
Organic and volatile matter	34·10	containing nitrogen	1·51
Ash	50·47	" P_2O_5	2·17
	100·00		

As regards the phosphoric acid contained in sewage sludge, it seems to be chiefly in combination with alumina as precipitated phosphate of alumina. In one sample a mere trace of phosphoric acid was dissolved out by prolonged boiling with acetic acid, and in the other two insignificant fractions. On the other hand, a large proportion of the phosphoric acid in all three samples was soluble in citrate of ammonia of sp.gr., 1·09, the recognized reagent for phosphoric acid precipitated in combination with lime, iron or alumina. One result of the experiments now being described is that they give a very decided manurial value to this precipitated phosphate of alumina; excellent crops of swedes being obtained with the sludge under circumstances where, without assimilable phosphates, no crops worth speaking of could be grown.

Having little more than 5cwt. of each kind of partially dried sludge at my disposal by the beginning of May, I was not able to undertake any very extensive series of trials, or to arrange my plots on a very large scale. I, therefore, marked out 20 plots of $\frac{1}{40}$ acre each, on No. 7 field of the College farm, then about to be sown with Swedish turnips. No. 7 is a field of 25 acres on the chalk downs; the soil is a thin, poor, calcareous gravel or sand, requiring to be liberally treated in order to yield fair crops. I selected this field because it was in particularly poor condition, having received no farmyard manure since 1880, at all events. In the spring of 1882 it carried vetches, followed by late turnips fed off on the ground by sheep; a crop of oats was taken in 1883, after which the field was ploughed up and lay fallow until May, 1884, when, as mentioned above, it went into swedes. Like all the chalk down fields, after a similar course of treatment, it was then incapable of growing an agricultural crop of swedes or turnips without the employment of superphosphate or of farmyard manure —the yield of the few unmanured plots varying from 3½ tons to 7¼ tons per acre of small and ill-shaped roots.

About the end of May the field was cross ploughed, twice dragged, twice harrowed, and rolled. The whole field, except the experimental plots, was then drilled, by means of a Reeves' water drill, with 3lb. seed and 4cwt. mineral superphosphate per acre. The superphosphate used was of ordinary quality, containing 26½ per cwt. of tricalcic phosphate rendered soluble. This quantity of superphosphate, without any farmyard dung or other nitrogenous manure, sufficed to give a good, even crop of swedes over the whole field, the yield averaging 11 to 13 tons of roots per acre. It was at one time in contemplation to top-dress the crop with 1 or 2cwt. nitrate of soda per acre, but the utility of this was considered doubtful, and the results obtained with the two experimental plots which received nitrate of soda in addition to superphosphate, seem to show that no adequate return for the expense of such a top-dressing would have been obtained. It must be borne in mind that swedes and turnips respond especially to the application of phosphatic manures, and that in many cases little or no result is obtained by the addition of nitrogenous manures.

The experimental plots were each 110 × 22·7 links, the width being exactly twice the width of the drill, so that the ten rows of seed assigned to each plot were deposited during one forward and one backward journey of the drill. The 20 plots formed 20 oblong strips, ranged side by side, and numbered in regular order from the lowest (No. 1) to the highest (No. 20), between which the ground sloped uniformly. In consideration of the rather small size of the plots, and of the irregularity introduced into all manuring experiments by the natural variation in the soil, as many as four out of the twenty plots were left unmanured. These were Nos. 1, 8, 14, and 20, and the results obtained on these show that the worst patch of land was in the neighbourhood of No. 8, the best land was between No. 14 and No. 20, and the land in the neighbourhood of No. 1 was of intermediate quality. It is very important to bear this in mind in interpreting the results obtained, which would otherwise appear to contain anomalies. One of the unmanured plots (No. 14) yielded more than double the crop obtained on another unmanured plot (No. 8) the difference being occasioned chiefly by the very variable depth of soil in fields of this character, the underlying chalk being nowhere far from the surface, and in some spots being so close as to be turned up by the plough.

Most of the manured plots were in duplicate, the individuals of each pair being placed at a distance of several plots apart. The result of this arrangement is that although two similarly treated plots may not yield even approximately equal weights of roots, yet the mean of each pair is rendered much more reliable than when two similarly treated plots adjoin each other.

The plan of the plots, the kind and quantity of manure used on each, and the weight in pounds of nitrogen and phosphoric acid per acre supplied by each dressing, are set forth in the annexed diagram:

ARRANGEMENT OF PLOTS AND DRESSINGS, *PER ACRE.*

20.	UNMANURED.	
19.	2 cwt. Superphosphate = 2 cwt. Nitrate of Soda =	26½lb. phosphoric acid (P_2O_5). 35lb. nitrogen.
18.	5 tons Leyton Sludge =	180lb. phosphoric acid. 120lb. nitrogen.
17.	2 cwt. Superphosphate =	26½lb. phosphoric acid.
16.	5 tons Coventry Sludge =	173½lb. phosphoric acid. 97lb. nitrogen.
15.	2 cwt. Ground Coprolite =	56lb. phosphoric acid.
14.	UNMANURED.	
13.	5 tons West Ham Sludge =	243½lb. phosphoric acid. 172½lb. nitrogen.
12.	5 tons Leyton Sludge......	See No. 18.
11.	4 cwt. Superphosphate =	53lb. phosphoric acid.
10.	4 cwt. Ground Coprolite =	112lb. phosphoric acid.
9.	10 tons Farmyard Manure =	about 60lb. phosphoric acid. " 120lb. nitrogen.
8.	UNMANURED.	
7.	5 tons Coventry Sludge....	See No. 16.
6.	2 cwt. Superphosphate.... 2 cwt. Nitrate of Soda	See No. 19.
5.	2 cwt. Ground Coprolite ..	See No. 15.
4.	2 cwt. Superphosphate....	See No. 17.
3.	5 tons West Ham Sludge..	See No. 13.
2.	5 tons Farmyard Manure =	about 30lb. phosphoric acid. " 60lb. nitrogen.
1.	UNMANURED.	

The dressings of farmyard manure and of sewage sludge were spread on their respective plots and ploughed in, and the ground harrowed and rolled before drilling the seed. The dressings of superphosphate and of coprolite were simply broadcasted by hand before drilling. The nitrate of soda on

plots 6 and 19 was applied as a topdressing on July 18th, after the hoeing, cutting out, and singling of the plants.

The whole field, including the plots, was sown with swedes, on May 30th, 1884, and following days, during a spell of fine dry weather, with easterly winds. Rain, however, fell a few days afterwards, and the plant came up over the field much better than had been expected. The entire season was too dry to be very favourable to root crops or to the action of manures, but a very fair crop was nevertheless obtained all over the field and on such of the experimental plots as had been suitably manured. Patchiness here and there showed the influence of the dry weather experienced during the early days of growth. There was a good deal of mildew on the leaves, and as regards the plots, the plants on the unmanured plots were observed to be the greatest sufferers. A certain degree of clubbing, also, was observed in the roots on these unmanured plots. Very striking differences between the various plots were visible from the first appearance of the plant, and towards the end of the period of growth the worst plots, viz., the unmanured ones, and the best plot, viz., that which received the heaviest dressing of farmyard manure, could be easily identified from the opposite hillside. The roots on all the plots were pulled the first week in December, counted into heaps on the ground, deprived of their leaves, and weighed. The number of roots on each plot, gross weight of roots, and average weight per root, are given in the annexed table. The mean yield of each set of plots is calculated into tons and cwts. of roots per acre.

Manure per Acre.	No. of Plot.	No. of Roots.	Weight.	Weight per Root.	
			lb.	oz.	
None	1	429	315	12¾	= 6 tons 3¼ cwt. per acre.
	8	325	195½	9¾	= 3 ,, 9¾ ,, ,,
	14	500	400	12¾	= 7 ,, 2¾ ,, ,,
	20	326	385½	18¾	= 6 ,, 17¾ ,, ,,
	Mean.	395	331½	13½	= 5 ,, 18 ,, ,,
5 tons Farmyard Manure	2	466	564	19½	= 10 tons 1½ cwt. per acre.
10 tons Farmyard Manure	9	554	760	22	= 13 tons 11½ cwt. per acre.
2 cwt. Ground Coprolite	5	461	467	16	= 8 tons 6¾ cwt. per acre.
	15	513	515	15¼	= 9 ,, 3 ,, ,,
	Mean.	504	491	15½	= 8 ,, 15¼ ,, ,,
2 cwt. Superphosphate	1	400	358	14¼	= 6 tons 8 cwt. per acre.
	17	461	674	23¼	= 12 ,, 0¾ ,, ,,
	Mean.	432	516	18¾	= 9 ,, 1¼ ,, ,,
4 cwt. Coprolite	10	459	420	14½	= 7 tons 10 cwt. per acre.
4 cwt. Superphosphate	11	508	622½	19½	= 11 tons 2¼ cwt. per acre.
2 cwt. Superphosphate 2 cwt. Nitrate of Soda	6	485	440½	14½	= 7 tons 17¼ cwt. per acre.
	19	360	597½	26½	= 10 ,, 13¼ ,, ,,
	Mean.	423	519	20½	= 9 ,, 5¼ ,, ,,
5 tons West Ham Sludge	3	407	473½	18½	= 8 tons 9 cwt. per acre.
	13	527	583	17¾	= 10 ,, 8¼ ,, ,,
	Mean.	467	528¼	18	= 9 ,, 8½ ,, ,,
5 tons Coventry Sludge	7	470	423	14½	= 7 tons 11 cwt. per acre.
	16	440	622	22½	= 11 ,, 2¼ ,, ,,
	Mean.	455	522½	18½	= 9 ,, 6½ ,, ,,
5 tons Leyton Sludge	12	534	538	16	= 9 tons 12¼ cwt. per acre.
	18	403	605	21	= 10 ,, 16 ,, ,,
	Mean.	469	571½	20	= 10 ,, 4 ,, ,,

Arranging the crops in order of merit according to the mean results given above, we have :—

		Tons.	Cwt.	
1.—10 tons Farmyard Manure	(1 plot)	13	11¼	roots per acre.
2.—4 cwt. Superphosphate	(1 plot)	11	2¼	,, ,,
3.—5 tons Leyton Sludge	(2 plots)	10	4	,, ,,
4.—5 tons Farmyard Manure	(1 plot)	10	1½	,, ,,
5.—5 tons West Ham Sludge	(2 plots)	9	8½	,, ,,
6.—5 tons Coventry Sludge	(2 plots)	9	6½	,, ,,
7.—2 cwt. Super., 2 cwt. Nitrate.	(2 plots)	9	5¼	,, ,,
8.—2 cwt. Superphosphate	(2 plots)	9	4¼	,, ,,
9.—2 cwt. Coprolite	(2 plots)	8	15½	,, ,,
10.—4 cwt. Coprolite	(1 plot)	7	10	,, ,,
11.—Unmanured	(4 plots)	5	18	,, ,,

The only result in this series of averages that I consider open to much doubt is that which places the manurial effect of 4cwt. ground coprolite below that of 2cwt. The 4cwt. coprolite was tried on one plot only, and this was next but one to the worst unmanured plot of the series (No 8); whereas the 2cwt. of coprolite was tried on *two* plots, each situated near the good unmanured plots. We may therefore disregard this comparison, which is, moreover, a little outside of the present discussion.

The best plot, in spite of its unfavourable situation, was that which received the heavy dressing of 10 tons farmyard manure per acre. Next comes the one receiving 4cwt. superphosphate. The crop on this plot was fairly level with the yield over the rest of the 25 acres of roots all receiving the same dressing. And it is worthy of notice that these two plots represent ordinary farming practice—a good dressing of dung, if it can be spared, if not, 4cwt. superphosphate per acre, or its equivalent in dissolved bones or any similar manure.

We next come to the smaller dressing of five tons farmyard manure per acre, giving a crop slightly less than that of an equal weight of Leyton sludge, slightly greater than that given by equal weights of the other two sludges. The actual results given by equal weights of the three sludges, are in fact, practically the same, although the Coventry and Leyton sludges contained scarcely more than two-thirds of the phosphoric acid, and scarcely more than half of the nitrogen supplied in the West Ham sludge. I attribute this discrepancy entirely to the fact previously mentioned, that the West Ham sludge was much too hard and cloddy to be reduced to a proper state of division by farm implements and operations. It was considered, at the time of putting it on, a most unpromising manure by those who had to do with it, and although, much to their surprise, it produced a very fair crop of uniform, well shaped, and excellent roots, a glance at the actual weight of phosphoric acid and nitrogen contained in the various dressings will show that the manurial constituents contained in it did not exert more than a fraction of their proportionate effect. The same observation is true, to a smaller extent, of the other sludges.

We are faced, indeed, with the fact that 53lb. of phosphoric acid in superphosphate, without the addition of any nitrogenous manure, or 60lb. phosphoric acid in farmyard manure accompanied by 120lb. nitrogen, produced a considerably larger crop than 180 or 240lb. of phosphoric acid *plus* 100 or 170lb. of nitrogen applied in the form of sewage sludge.

As regards the nitrogen, we are, I think, debarred from attempting any comparisons. The application of 4cwt. superphosphate alone, without any nitrogen, produced not only on the plots but over the whole field, an excellent crop of roots, and one only slightly inferior to that obtained by the highly nitrogenous heavy dressing of dung, which was at the same time richer in phosphoric acid. Moreover the 2cwt. of superphosphate without nitrate of soda, has produced almost exactly the same yield as when supplemented by a top dressing of 2cwt. of nitrate. So general is the experience of farmers in this respect, that the use of nitrate as a top dressing for turnips or swedes is very exceptional, and where guano, dissolved bone or other nitrogenous fertiliser, is used instead of the much cheaper mineral superphosphate, the economy of such a course is very often doubtful. I believe the true statement of the case to be that a moderate crop of roots (*i.e.* turnips and swedes) is in most cases more cheaply grown with 2 to 4cwt. mineral superphosphate per acre than with any other dressing ; and when the crop is to be forced beyond this point nitrogenous manure must be used in conjunction with *heavy* doses of phosphoric acid.

Coming back to the fact that the phosphoric acid of the sludges (without reckoning the nitrogen) did not exert more than one-fifth of its theoretical effect, I find the explanation in the unsuitable physical character of the cakes of sludge as they leave the filter-presses, or even after being air dried. The newly-pressed cakes, containing 50 per cent. or more of water, are considerably richer in nitrogen than farmyard manure, and more than double as rich in phosphoric acid ; and a large proportion of this phosphoric acid is soluble in citrate of ammonia. Nevertheless, we find that these cakes, even when air-dried down to 20 per cent. of water, are of no greater manurial value, weight for weight, than farmyard dung. The loose texture of farmyard manure, its large percentage of soluble constituents, when well rotted, and its readiness to undergo oxidation, all favour the distribution of its fertilizing elements throughout the soil ; the closely compacted particles of pressed sludge, on the other hand, offer the greatest resistance to mechanical and chemical disintegration. As a matter of fact the sludge plots, in my experimental series, were all readily identified when the roots were pulled by the presence of unbroken and undecomposed clods of cake, which had evidently given up at most a small portion of their valuable ingredients to the soil. The utmost a farmer can be expected to do, who buys and carts away the sludge direct from the presses, is to loosely stack the cakes under cover until they have air-dried to a certain point, which it is important not to stop short of, nor to go beyond. With most sludges I should take this point to be reached when the sludge contains rather under 20 per cent. of water. The cakes are then as friable as they are capable of becoming, and like soil when in a fit condition for ploughing, dragging, harrowing, and rolling, they may be cultivated down to a certain fineness of tilth by ordinary farming appliances. But the fineness attainable in this way is far from being sufficient, in the case of sludge cakes, to give them anything like their full manurial value. To effect this, I consider that they should be reduced to as fine a state of division as guano or superphosphate, and from such a product I should expect to get as high a "duty" per unit of nitrogen and of phosphoric acid as can be got from farmyard manure. It is clearly impossible to grind the sludge finely without first drying it, and this drying is also highly desirable, in order to produce a manure of sufficient value to pay for transport by rail to a moderate distance. Dried and ground sludge containing 1½ or 2 per cent. of nitrogen and 2 or 2½ per cent. phosphoric acid should be worth something like £1 10s. or £2 per ton, if we value the nitrogen at 12s. per unit, and the precipitated phosphoric acid at 4s. per unit. It must be understood that I merely use these figures for the purpose of illustration, and even a considerable alteration in these will not destroy the form of my argument. The price actually realized by the wet sludge, containing 50 per

cent. of water, is, I am informed, but 2s to 2s. 6d. per ton at Coventry, and at most places the sludge is quite unsaleable, and has to be carted away at the public expense, and got rid of in a more or less mysterious manner. It is, for example, taken down the Thames in barges, and pitched into the river at what is considered a safe distance from the Metropolis. I gather from Mr. Hutchinson's paper, already referred to, that the cost of filter-pressing sewage sludge does not exceed 2s. 6d. per ton of pressed cake at Coventry, although the pressing is there carried out under rather disadvantageous conditions. With more than half the water removed from the sludge at this trifling cost, it seems to me not unreasonable to suppose that the cakes of sludge can be dried, ground, and marketed as a manure at a price which should pay all necessary and proper expenses. A good deal of the remaining water can be removed from the pressed cakes by air-drying under suitable conditions, and if the air-dried sludge is ground in its most friable state the cost of grinding should be small.

Although the matter contained in this paper is perhaps rather agricultural than chemical, I have preferred to read it before a society of chemists and engineers, because at present the sewage sludge question concerns them, and not the farmers. Farmers cannot reasonably be expected to buy or bother themselves with such an unpromising material as wet sewage sludge even in its filter-pressed condition, although that is a great advance on anything attainable before the era of filter-presses. On the other hand I see no insuperable obstacle to bringing it into a form in which farmers would be glad to buy it at its full value—and possibly at more.

I have procured through Messrs. S. H. Johnson & Co., another sample of Coventry sludge, dried and ground as suggested in this paper. It is a fine dry powder, not offensive in any way, and contains by analysis only 13½ per cent. of water. In its dry state it contains 75 per cent. of mineral matter, a figure almost identical with that of the sludge from the same works experimented with last Spring. With this sludge, and another dried and ground sample resulting from Hanson's process of sewage precipitation with lime and alkali waste, I intend to experiment this season on a crop more responsive to nitrogenous manures than swedes or turnips, and I am confident of getting out of the sludge results closely approaching its calculated manurial value. I have added to the list a sample of the Native Guano prepared by the A.B.C. process—a sewage product which, chiefly owing to the attractive form in which it is offered, has for several years sold at least up to its full calculated value.

Manchester Section.

Chairman: Sir H. E. Roscoe.

Vice-Chairman: D. B. Hewitt.

Committee:

R. F. Carpenter.	J. Knowles.
C. Estcourt.	I. Levinstein.
H. Grimshaw.	C. Schorlemmer.
Peter Hart.	Watson Smith.
J. von Hohenhausen.	Wm. Thomson.
T. Jackson.	D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Tuesday, November 25th, 1884.

MR. WATSON SMITH IN THE CHAIR.

The Chairman in the first place briefly called attention to the fund which is being raised on behalf of the widow and family of the late Mr. Henry Watts, F.R.S., and in doing so referred to the good example set by the Birmingham Section. (See notice on the first page of present issue of this Journal, and page 609, vol. III.) Secondly, he directed the notice of members to the full abstract of a Rivers' Pollution Bill, prepared by Mr. Hastings, Earl Percy, and Col. Walrond, appearing in the November number of the Journal for 1884, and hoped they would carefully consider the text of this bill with a view to preparation for an early discussion on the subject, one of the greatest importance for chemical manufacturers. He then called on Mr. Sansone to read his paper:—

TURKEY RED AND ALIZARIN DYEING ON COTTON.

BY A. SANSONE,

Dyeing School of the Manchester Technical School.)

I intend to give to you first a brief outline of the process of Turkey red dyeing in order that I may afterwards be able to discuss the scientific principles on which rely this important process of manufacture.

Turkey red dyeing has experienced a complete transformation in the last 10 or 12 years, and much progress has been made in this branch of industry, but in spite of this we are as much in the dark now about the theory of the formation of the brilliant red lake on the fibre as we were 20 years ago, in fact the theory has still to be made. It is especially in the important preparatory process of the oiling of the goods where no satisfactory explanation has been given until now.

We have seen a new method of oiling of the goods introduced into practice, and we have seen the old emulsive or Gallipoli oil (the *huile tournante* of the French) to a great extent driven out of the Turkey red dye works by the modern preparations from castor oil, and we may see perhaps the latter superseding the former completely, and not even then, I am afraid, shall we have had an explanation of the theory of its employment.

Turkey red dyeing, as many other useful arts, has come to us from the East, and judging by its name, it must have been through Turkey that it has penetrated into Europe, and in fact the town of Adrianopolis was at one time famous for the reds it produced, and both in French and Italian the translation for Turkey red is Adrianople red. The processes, as they were originally practised, varied of course greatly from those at present in vogue, and like in all other industries Turkey red dyeing has passed through several stages of progress. At the time of madder dyeing great improvements were made already in shortening the length of the processes, and also in reducing to a minimum the amount of the raw materials employed. At one time as much as 50 per cent. of emulsive oil was used for the oiling of the goods, while the amount of alum was also over 50 per cent., and as far as madder was concerned 150 per cent. and 160 per cent. of the weight of the cotton was believed to be necessary for obtaining full shades. Little by little these amounts came to be considerably reduced and brought down to more reasonable proportions. The time employed was at first also very

long, and was originally counted by weeks, then by days, until in some works it was boasted that a good Turkey red on yarn could be dyed in three days, and I know of an old dyer who could accomplish this feat, although the process in ordinary work would take much longer, but I know for certain that it could be done, and was actually done in some cases. The introduction of garancine at the time also brought about a further improvement, and the clearing processes were also considerably shortened. But artificial alizarin has caused the great revolution in the practice of Turkey red dyeing, and the transformation has been completed by the introduction of the Turkey red or alizarin oils.

But in my mind we are not yet at the end of the transformations in this industry, and no doubt a quicker method of dyeing will be introduced at some future time.

I consider that we are now in a transitory stage between the old method of the Turkey red dyeing and the future processes, which will once be introduced when we shall have more knowledge as to the theory of its formation than we now possess.

The older processes required the cotton to be oiled several times (six or more times), and each treatment with the oil was followed by long exposure in the fields; later on stoves were introduced, and the number of oil passages was little by little reduced until ultimately three passages were found sufficient, while by the modern processes one previous passage in a good castor oil preparation is deemed sufficient to produce a good colour.

Alizarin was introduced into the Turkey red dye works in 1871 and 1872; and in 1873 I visited, in company with a friend, some of the principal Turkey red dye works in Switzerland and found that alizarin had displaced madder completely, and this in spite of the high price at which alizarin was sold at that time. The speedy success of artificial alizarin was due principally to the brighter shades that could be obtained, and the shortening of the processes, which required no more such heavy preparation of the yarns and such severe and expensive brightening operations, although it must be said also that Turkey red yarn dyed with alizarin was received at the time with great mistrust, and that it encountered some opposition at the hands of the weavers, who complained that the cotton was too greasy and could not be easily sized for weaving. There was in fact a certain amount of truth for this complaint since the yarns which were dyed at the beginning were dyed on cotton which had undergone the same oiling operations as for madder, but had not been exposed to the long boiling in soap and soda when brightening as by the old process, and therefore all the useless fat had not been removed, but this difficulty was soon got over and alizarin established itself in the practice of the works, although it was maintained by many dyers that the new reds could not be so fast as those obtained by means of madder. This assertion was also easily disposed of when the new reds had been fairly tried, and the goods produced found to answer just as well as those obtained by means of madder, which could beside never have produced the same bright shades obtained by means of alizarin. Although Turkey red goods are now mostly produced by means of the artificially prepared Turkey red oils or alizarin oils I do not mean to say that olive oil has been completely abandoned, and some establishments still use the latter for the oiling of their goods, and employ, in a certain way, a modified form of the old and classic process of Turkey red dyeing, and some still employ two weeks, and some even four weeks, in the production of their reds, and claim to obtain better results than by the new and shorter process,—in fact some dyers go so far as to assert that truly fast colours can only be obtained by oiling the goods in the old fashioned way, and that the reds produced by means of modern Turkey red oils, although of very bright shade, do not come up to the others in point of fastness.

I think, however, that if a modern process of Turkey red dyeing be well conducted, as bright and as fast colours can be produced as by the modified old method. The other assertion that colours dyed with alizarin are not so fast as those formerly dyed with madder has been disproved over and over again, and over ten years' experience of the alizarin dyed colours are a convincing proof that such is certainly not the case.

If I dwell on this point it is principally on account of a most astonishing statement which has appeared in some foreign journals, and has been reproduced by the *Manchester Guardian* (of the 4th of this month), viz., that the culture of madder was about to be started again in France, and that the question was seriously being discussed in commercial circles at Avignon.

That the countries and the districts that had once the flourishing madder culture still entertain hopes of their being able to resume its cultivation is a fact that no one need be astonished at, and last year while still in Italy, and in a place near Naples where madder was very extensively cultivated, I was repeatedly asked if there was any probability of madder being employed again in dyeing and printing, since it was stated that some agriculturists intended to resume its cultivation, and there are some of them who year after year have been in the habit of planting small lots of madder root in order to obtain the seed, with the hope that the profitable cultivation of madder would once more be established. Alas, for their hopes, I am afraid madder cultivation is now a thing of the past, and will never be resumed. I am, so to say, directly interested in this subject, since my family was extensively engaged in the madder trade, and the appearance of alizarin caused a great loss to the place where I was born.

I should not have mentioned this matter but for the other assertion found in the article of the *Guardian* above referred to, in which it is stated: "It appears that after several years experience printers and dyers are manifesting a distinct tendency to return to the use of vaucluse (French) madder." It is further stated that prices are rising, and the demand increases daily.

As a matter of fact madder has been for the last few years only employed in pretty large quantities in woollen dyeing, cotton dyeing, and printing, only taking limited quantities, especially in the United States, where on account of the monopoly alizarin has been sold for several years at double the price that it was paid for in this country.

The rise in prices may have been caused by the exhaustion of old madder stocks existing, but certainly not by the increased demand from cotton dyers or printers. And as far as woollen dyeing is concerned after Mr. Hummel's interesting paper, to which we had the pleasure to listen at our last meeting, and the results obtained, there is ground to expect that madder will also be driven off from this branch of industry.

I intend to describe now in a short way the modern process of Turkey red yarn dyeing as it is generally carried on, but I must here observe that the methods vary a great deal according to the different works. I will devote my remarks especially to the dyeing of yarns, although I must say that the same methods, with a slight modification, can also be employed for cotton cloth.

The goods are first boiled or scoured in closed apparatus, generally working under pressure ; in some cases iron kiers worked by steam are employed for the purpose, in some others, and this especially on the continent, copper vessels are used heated by steam or free fire ; soda ash is principally employed as the scouring agent. After this operation some dyers in this country make it a practice to pass the goods through the bleaching process in order to have the yarn white or half white, while in my own country, or at all events in our case, we never did and never do bleach our yarns before dyeing, as we find the sun does the work for us, since we do all our dryings in the open air, of course when the weather allows, and we can see the cotton whiten under the influence of air and light during the different operations of mordanting the goods.

After the scouring or bleaching, the goods are well washed and dried again, then follows *the oiling*, which is a very delicate operation, and on which depends the success or failure of the subsequent operations.

The prepared oil for Turkey red dyeing is either bought ready made or is prepared in the works ; in either case it must be said that if no properly prepared oil is at command no good results will ever be obtained. The Turkey red oil goes under different names in the trade, as for instance : alizarin oil, olein, &c., and is manufactured by several firms here and abroad of excellent quality. It is simply dissolved in water in different proportions according to the depth of shade required, the amount varying from 5 to 12 or 15 per cent. of oil to 100 parts of water, to which sometimes a small quantity of ammonia is added to be sure that there is no free acid in the oil solution. The yarns are passed in this oil solution, then wrung. For these two operations special machines have been devised, which have been found for years very useful in Turkey red yarn dye works, and which perform both the passing of the hanks in the oil preparation and wringing. Sometimes also specially constructed presses are used for the purpose of squeezing out the surplus of the oil mordant, but where no machinery can be employed both operations of mordanting in oil and wringing are performed by hand, care being taken in all cases to do the wringing as evenly as possible in order to obtain even colours.

After wringing the hanks are first dried in the open air, where this is possible, or else brought at once into the stoves where they are left for several hours, and this not only for the purpose of solely drying the goods, but also in order to fix or rather to modify the oily preparation that it will act afterwards as a mordant. The temperature of the stove must not be too high, especially at the beginning, or else uneven colours will be obtained ; about 50° C. is deemed by some sufficient, while others go even higher or lower according to their experience. Some dyers prefer to give two passages in oil instead of one. The hanks are taken from the stove and mordanted with acetate of alumina (red liquors.) Here again different opinions prevail, some use acetate solution of 6° or 8° Tw., some use it more concentrated, some use even it weaker, some employ a basic acetate, all depends of course from personal experience. When mentioning of the theory of the formation of the red lake on the fibre it will be seen that not knowing the exact chemical combination that takes place in the process there is no rule to go by, and it is only by experience that we can judge of the different conditions of working, and the amount and strength of raw materials to be used in order to obtain bright reds.

For the operation of mordanting in acetate of alumina the same kind of machines are employed which are used for the oilings, and of course the wringing must also follow.

The hanks are dried again in the stove, and possibly dyed in the same way as pieces are generally dyed in the printworks, if not they are left to air for a day or two, and this in order to fix as much alumina on the fibre and to drive away the acetic acid.

The dunging is a necessary operation in the modern process of Turkey red dyeing, and this operation is performed in a hot bath principally by means of chalk (whiting) and cow dung, or by means of binarseniate of soda. Afterwards follows a thorough washing, and the goods are ready for *dyeing*. This also is a very delicate operation, and the brightness of the colours also depends from the way it is performed. To prepare the dyebath special brands of alizarins are used, generally known in the trade by the name of alizarin for Turkey red. There are two varieties : one blue shade the other yellow shade, and either one or the other, or a mixture of both is employed, according to the shade which is required, as some markets prefer a yellowish red, while others a bluish brand. I find that the best reds are obtained with products neither too yellow nor too blue. Here also it is only experience that teaches which is the best brand of alizarin to be employed. As a rule all large firms of alizarin manufacturers supply good products for the purpose.

Mr. Levinstein in his interesting address on the alizarin industry, says that it were advisable if makers would offer for sale only the three distinct colouring matters : alizarin, isopurpurin, and flavopurpurin, leaving to the dyers and printers the mixing according to the proportion required, and I am of the same opinion.

The bath is made up with about 7 per cent. to 8 per cent. of alizarin at 20 per cent., and all sorts of ingredients have been recommended to be added to the bath ; some dyers have added blood, as it was the general practice when dyeing with madder, some have added glue, some others add a little chalk, acetate of lime, &c., while others find that a small quantity of the alizarin oil and a very small quantity of tannic acid is beneficial, the latter, however, must not be added in large quantity, or else the resulting red, although faster, will lack in brilliancy.

The question of the water is also of great importance, and some chemists go so far as to recommend only distilled water for the dyebeck ; if the water is not too calcareous it can be employed without any further treatment, while in the case of very hard water it is well to correct the same before use.

The dyeing is started quite cold, and then it is heated very gradually, so that in $1\frac{1}{2}$ to two hours it is brought to about 70–75° C. (Some dyers do not even go so high.) The yarns are, of course, worked all the time, either by hand or by machinery, and the dyebecks are generally made of wood, and heated by steam ; and, sometimes, especially in old dyeworks on the Continent, they are made of copper, and are sometimes heated on free fire. Iron vessels I do not like on principle, in fact, for Turkey red dyeing, according to my opinion, iron ought to be avoided as much as possible ; and the yarn while working ought never to be allowed to touch any iron ; as many lots have been sometimes spoilt by the goods coming in contact with nails, pipes, etc. ; and where the iron had touched the cotton, purple spots were formed, which would never disappear. I must say, however, that iron dyebecks for alizarin dyeing, which are so much used in English printworks, do not seem to give any trouble. Very likely after a little use, the iron becomes coated with a thin film, which prevents the further action of the metal. Whichever be the material, or the form of the dyebecks, care must be

taken that the heat be evenly distributed all over the vessel, or else uneven results will follow; in fact, it is advisable to have one or two perforated false bottoms in the beck, in order to compel the steam to pass through the holes, and thus to be distributed all over the dyeing apparatus. A special set of men are generally employed in the works for the dyeing, and, as a rule, they do nothing else but attend to the dyeing, and these men acquire by long practice great dexterity in the art, since it is really an art if the work is done by hand.

In our own place two men can dye in four times, about 400 lbs. of yarn per day; that is, they do four dyeings of 100 lbs. each; and I may add that labour is very cheap over there.

When the bath has reached the desired temperature, the cotton is lifted out of the bath, left to cool, wrung, and dried.

Then follows a second oiling, in which less oil is employed than in the previous one; some dyers add to this oil bath a small quantity of tin crystals and a little ammonia.

The tin chloride which is sometimes also added when the goods are mordanted with acetate of alumina, gives more brightness to the reds, to which it imparts besides a yellowish hue.

The yarn is dried again after the second oiling, and steamed.

Here again the practice varies a good deal in the different works; some steam one hour, some longer, some under pressure, some without, etc. The apparatus employed are sometimes horizontal boilers, hermetically closed, on the same principle as those employed by calico printers; in some other cases they are simply constructed of masonry, as a kind of cistern; in some others, wooden boxes are used. But brighter reds are obtained if the steaming is performed under pressure.

After steaming, the goods must pass the last process of brightening, or rather boiling with soap, in order to remove all the substances which have not been fixed on the fibre, and at the same time in order to brighten the red; this is a necessary operation if fiery reds are required, and it is performed in well-fitted works under a certain amount of pressure by means of a few percentage (about five per cent.) of soap, with the addition of small amounts of soda ash and tin crystals, which are both sometimes also dispensed with. The quality of the soap is of the utmost importance, since if it is at all alkaline it will impoverish the red; therefore a soap must be used which is completely neutral and has been well boiled (thoroughly saponified).

Finally, the goods are washed, dried, and finished, and if intended for export they are made up in bundles of a peculiar form.

As you will easily see, the process as described is anything but a short process, as it is sometimes called, and it is still capable of further shortening and improvements. In some cases it has been tried to do away with the first oiling of the goods, and the cotton has been mordanted at once with acetate of alumina, or other suitable alumina mordant.

Aged, dunged, and dyed with alizarin, then dried, oiled, and steamed, then soaped; and good results are, in fact, obtained by this method, and a large quantity of cotton yarns and cloth are dyed by this shorter process, but I do not consider that by this method as bright and as fast colours can be obtained as by a thorough Turkey red dyeing process, and, in fact, in the trade a distinction is made between Turkey red and alizarin red.

There are, however, some dyers and printers who, by a modification of this shorter method, can produce reds which come very close to Turkey red, in point of brilliancy, but which are, however, not so fast.

At all events, my personal opinion on the matter, judging from the little experience I have on the subject, is that unless the goods are properly oiled, no proper Turkey reds can be obtained; the colours obtained may be almost as bright, but they will not possess the same fastness as those obtained by the old or rather by the modified classical process of Turkey red dyeing.

The old process is still carried on to a larger extent than is generally believed, and I think the majority of the Scotch dyers still adhere to it.

A good Turkey red will stand bleaching, and, of course, severe soapings, while an ordinary alizarin red will not stand bleaching so well. I want to call now your attention to the patterns and specimens for which I am obliged to two eminent firms who have carried on for years the manufacture of Turkey red goods. I take this opportunity also of thanking the gentlemen belonging to each of those two firms for allowing me to show these patterns to you.

In the production of Turkey red dyed and printed goods this country stands in the front rank for the importance of the quantity produced, and as far as brightness of shade is concerned, the reds produced in Lancashire and Scotland are as fine as those which are produced by the best works on the Continent; but it must be said also that if the Continental production does not come up in quantity, the colours produced abroad are certainly not inferior to those produced in England. I now pass over to the theory of the Turkey red dyeing process.

I must say, to begin with, that there are, and there have been for years, two theories: a chemical theory and a mechanical, or, rather, physical theory.

While some maintain that the fatty substance takes part in the formation of the red lake, by forming chemical combination with alumina and alizarin, others maintain that the oil or fatty matter acts mechanically, by surrounding the alumina alizarin lake in such a way that it forms a kind of coating around the same, and it makes it thus capable of standing the action of soaping and other reagents in a much better way than when it is not protected. The brightness of the Turkey red lake is also explained sometimes by comparison to a varnish, which imparts to a paint greater gloss and brilliancy; for instance, if an ordinary pigment colour is painted on wood, it has no gloss or brilliancy, but if a varnish is applied on the same colour then a quite different appearance will result.

If I have to express an opinion on the matter, I must say that all the explanations are correct if taken altogether, but that they are open to objectiou if taken separately. In my mind, the fatty substance combines really with alumina, and enters thus in the formation of the lake; and it acts also mechanically, by covering the lake so as to protect the same from the action of soap and other reagents; and it acts besides as a kind of varnish, and imparts thus to the red greater brilliancy.

A discussion is going on among Continental chemists on this very theory of Turkey red dyeing, and I beg to refer those who take interest in the subject to read the articles which have appeared lately in Dingler's Polytechisches Journal. Müller-Jacobs, on one side, considers the prepared oils for Turkey red (which, as well known, are obtained by treatment of olive or castor oil by means of sulphuric acid, washing with water, and neutralising with an alkali) as a solution of the undecomposed oil in the alkaline sulphooleate or sulphoricinate, and this solution would act as a mordant, by giving up to the fibre the undecomposed oil in a very finely divided form, and

therefore its action would rather be a physical than a chemical one, by enveloping the lake and thus protecting it from exterior influences.

Henry Schmid, an old schoolfellow of mine, does not admit this physical theory, but maintains that the oil enters into the formation of the lake ; he states besides that not only the oils prepared by means of sulphuric acid will act as mordants, but also if they have been treated in a different way. For instance, if castor oil is saponified by means of potash, and the soap decomposed by means of an acid, and the free fatty acid is separated and dissolved in alkali, the soap thus formed is very suitable for Turkey red dyeing.

He states further that an emulsion of oleic acid in water, obtained by very long shaking, can easily displace the sulpholeates in dyeing.

Liechti and Suida also propound a chemical theory, and contribute very valuable researches on the formations of the sulpho compounds in the manufacture of prepared oils for Turkey red dyeing.

The discussion is in able hands, and is not completed, and I beg to refer again those interested in this subject to the articles referred to. I will now try to explain on what grounds I found my belief that the theory of Turkey red dyeing rests both on chemical and physical principles :

Let us first of all consider the necessary ingredients for the formation of the Turkey red lake : we have alumina, then oil, then alizarin ; these three are really the components of absolute necessity, and the principal constituents of the red ; lime, of course, plays also an important part, and so does tin to a certain extent, and tannic acid plays also a pretty important part, but, of course, a secondary one.

Alumina, by whichever method it is fixed on the fibre, can be considered as hydrate of alumina more or less combined with the acid of the product originally employed ; for instance, we might have a basic sulphate of alumina, which, as well known, acts as mordant in the same way as pure hydrate of alumina. But let us suppose that we have pure hydrate of alumina on the fibre $Al_2(OH)_6$. We may also admit that we have pure alizarin at our disposal, and not isopurpurin or flavopurpurin, therefore $C_{14}H_6O_2(OH)_2$.

Then we bave the oil, which by saponification would yield glycerine and the fatty acid ; let us admit also in this case that we have free oleic acid at our disposal, $C_{17}H_{33}COOH$. I may remark here that in the absence of proved facts I may simply make use of my imagination to form a plan or theory, and possibly strike a formula, and I will bring forth my reasons for the opinions I hold. Let us suppose that the reaction could take place according to the following equations :—

$$Al_2\begin{cases} OH \\ OH \\ OH \\ OH \\ OH \\ OH \end{cases} + \begin{matrix} \begin{matrix} HO \\ HO \end{matrix}\!>C_{14}H_6O_2 \\ \begin{matrix} HO \\ HO \end{matrix}\!>C_{14}H_6O_2 \\ \\ \end{matrix} + \begin{matrix} HOOC.C_{17}H_{33} \\ HOOC.C_{17}H_{33} \end{matrix} = 6H_2O$$

Hydrate of alumina one molecule — Alizarin two molecules — Oleic acid two molecules

would form by elimination of water

$$+ Al_2\left\{\begin{matrix} \begin{matrix} O \\ O \end{matrix}\!>C_{14}H_6O_2 \\ \begin{matrix} O \\ O \end{matrix}\!>C_{14}H_6O_2 \\ O - COC_{17}H_{33} \\ O - COC_{17}H_{33} \end{matrix}\right\} \text{Aluminum alizarin oleate.}$$

Let us now examine if such a formula is possible. I have found by experience that good reds are obtained when, for 100 lbs. of cotton, about the following proportions are used :—

Alumina mordant corresponding to
20lb. of alum (potash alum)
Oil corresponding to
10lb. fatty acid
7lb. alizarin paste, 20%, containing about 1·4lb. dry alizarin.

Now the molecular weights are :—

For alum $K_2Al_2(SO_4)+24H_2O = 948·14$

Alizarin $C_{14}H_8O_4 = 240$ — Oleic acid $C_{18}H_{34}O_2 = 282$

As one molecule of alum corresponds to one molecule of hydrate of alumina, we would have :

Theory.	Practice.
948·14 alum, one molecule	20 alum
480 alizarin, two molecules	1·4 alizarin
564 oleic acid, two molecules	10 fatty acid

It will be seen that the amount of fatty acid and alum corresponds approximatively, but that there is great difference between the alum and the alizarin. Although it must be said that neither the alum nor the oil will all be fixed on the fibre, and that of the mordants employed, perhaps only three-fourths of the amount of the alumina and of fatty acids are really fixed on the fibre ; but even then the quantity of alizarin which is found necessary shows that the calculation of two molecules of alizarin for one of alum is too much. By taking it at one molecule of alizarin to one molecule of alum we would have :

Theory.	Practice.
Alum 948	20 alum
Alizarin 240	1·4 alizarin
Oleic acid 564	10 fatty acid

Even in this case we have a great discrepancy between the amount of alumina necessary and that actually employed and the alizarin, and even admitting that a great excess of alum is used, in order to fix a small quantity of hydrate of alumina, still it is certain that in this case at least three times as much alum is used as it is actually necessary.

But it is an old established fact that although cotton may have a certain amount of hydrate of alumina fixed on the fibre before soaping, that this quantity greatly diminishes after the clearing or brightening process, and as was proved in the case of madder dyeing the amount of alumina remaining on the fibre is always in a fixed proportion to the amount of the lime also found on the fibre by incineration.

The quantity of alumina mordant employed to fix a certain amount of alizarin on the fibre, either by dyeing or by printing, will be found to vary greatly in the different works, and comparing the processes and receipts published in the different books on calico printing, it will be found that there are not two authors who will give the same proportions of, say acetate of alumina and alizarin, but mostly agree in giving an excess of alumina mordant.

Therefore by taking, as it has been found in practice of dyeing that an excess of alumina is necessary, we may admit that one molecule of hydrate of alumina, and consequently of alum, would require one molecule of alizarin, as by the following equation :—

$$\underset{\text{Hydrate of alumina one molecule}}{Al_2(OH)_6} + \underset{\text{Alizarin one molecule}}{C_{14}H_6O.(OH)_2} + \underset{\text{Oleic acid two molecules}}{2C_{17}H_{33}CO.OH} =$$

$$4H_2O + Al_2(OH)_2.C_{14}H_6O_4.(CO.C_{17}H_{33})_2$$

Then we should have still 2OH group, which would be taken up by lime, *i.e.*:

$$Al_2\left\{\begin{array}{l} OH \;.\;.\;. \\ OH \;.\;.\;. \\ {O \atop O}\!>\!OC_{14}H_6 \\ COC_{17}H_{33} \\ COC_{17}H_{33} \end{array}\right. + \begin{array}{l} HO \\ HO \end{array}\!\!>\!Ca = 2H_2O + Al_2\left\{\begin{array}{l} {O \atop O}\!>\!Ca \\ {O \atop O}\!>\!OC_{14}H_6 \\ COC_{17}H_{33} \\ COC_{17}H_{33} \end{array}\right.$$

Ultimate formula would be: Lime, alizarin, oleic acid lake.

This formula, however, shows one of the many possible formulas, since there are, in fact, no experimental proofs, or, rather, analytical proofs, why two or more molecules of alizarin should not combine with the alumina, instead of one; and it is also not unlikely that the lime itself might combine with the alizarin, by taking up one valence, and thus form a lime alumina alizarate; the possible formulas are rather numerous. In the working of the above equations I simply intended to imply that there are good grounds for a thorough chemical theory, not wishing, however, to state that the formula should be exactly so as I have put them down. In the case of the fatty acid, I have admitted that we had pure oleic acid to work upon, and, in fact, if a prepared oil is used, made by saponification of the acid, it is very likely that the fatty acid enters in the formation of the lake as such, and this, I believe, is actually the case when dyeing an alizarin red; the oily preparation which is used at the end very likely enters in the formation of the lake by the action of the steam to form a kind of alizarin alumina soap lake; I think in this case the fatty acid has not the time to become modified, and enters as such in combination with the alumina. But it is different in the process of Turkey red when the oil is applied at the first on the cotton; in this case it is impossible, in my mind, to conceive that the fatty substance does not undergo any modification when exposed on the fibre to the action of the stoving or exposure to air; in the old process of Turkey red oiling we know for certain that the oil is modified by exposure to air, light, and heat, and that a modified oil mordant is really fixed on the fibre, and does not go away by washing; and, in my mind, when oiling by means of prepared oils, a similar process must take place, and, in fact, a mordant is fixed on the fibre which does not go off when the cotton is washed; but it is not likely that the same modification of the oil takes place in the new as in the old oiling process. It is very likely that in both cases it is a kind of oxydation of the fatty acid which takes place—similar to process of the drying of the linseed oil, but this fact has yet to be proved.

Liechti, Suida and Müller Jacobs speak of the formation of oxyoleic acid and oxystearic acid, and their further investigation will no doubt throw fresh light on this point. It may also be taken for probable that the modified oil does not pass through any molecular change, but simply adds oxygen, but that no change takes place in the acid radicle, and that it is again capable of combining with alumina lime in the same way as before. That there is good proof for admitting that the fatty acid enters really in chemical seems to me to be in the fact that both in the old and new process of Turkey red dyeing a certain amount of heat and pressure is required for the formation of the bright reds, since by the old process the boiling in the dyebecks is necessary for developing the colour, and that pressure is required in the brightning processes to obtain bright shades; in the new process the steaming and also the brightning under pressure produces the same effect. In other words, according to my opinion, it is by this heating that the real combination, in fact a real saponification, takes place. We could chemically define an alizarin red as a colour in which oleic acid (oromologues fatty acids) forms with alumina, alizarin and lime a combination, a true soap lake.

While in the true Turkey red we also form a soap lake, but the fatty acid is modified in such a way that it acts also physically by covering the lake and protecting the same from exterior influences.

The fact that in the old process of Turkey red such a large amount of the oil is used speaks also in favour of the physical theory, and it is in my opinion due to this excess of modified oil that Turkey red colours owe their fastness against soapings, etc.

It will be remembered that in the old process of Turkey red, especially for dyeing with madder, sumach was generally used; the employment of this can be easily explained by admitting the formation of tannate of alumina, or rather by the tannic acid of the sumach entering in combination with alumina to form a complex formula of alumina tannate, oleate, alizarate of lime.

In my mind there is great analogy between what takes place when the goods are oiled for Turkey red dyeing and the process of drying of linseed oil.

In both cases we have that if we were to employ the oils without any previous preparation that both processes would take much longer to take effect, for instance in the case of linseed oil, if we paint with the raw oil which has not been boiled, it takes several to dry, while the same oil after it has stood a proper treatment, such as is generally termed the boiling by means of a dryer such as litharge, red lead, etc., it acquires the property to dry in much shorter time, in fact in a few hours.

If we take castor oil or olive oil in the natural state they are not suitable for the process of Turkey red dyeing, or rather, if they are suitable for the purpose, they would take too long to accomplish the same object which is accomplished in a much shorter time if the oils undergo a proper preparation; in other words, we have to give to the olive oil or castor oil a treatment which, although different, bears great analogy to the process of boiling of the linseed oil.

I am sorry to say we are also as much, and perhaps even more, in the dark about the proper theory of the boiling of linseed oil, and we are still more ignorant of the chemical changes which take place in the drying, we know that an increase of weight takes place and, although it is stated that it is due to oxydation from the atmosphere, yet it has not been explained how this does happen.

From what I have said concerning the theory of Turkey red dyeing it is evident that much remains to be done until the process can be properly explained, and there is plenty of scope for chemists to devote their time to scientific and practical researches in this interesting branch of industry.

In my mind both the questions of oiling the goods and the drying of linseed oil ought to be studied at the same time, because there is some analogy between the two processes, although the ultimate results may be different, since olive or castor oil do not belong to the same class of oils to which linseed oil belongs.

I think it is also necessary that experiments should be conducted under the same conditions of exposure, temperature, etc., as they are performed on the large scale; I think also that the different reactions should not be tried by having the mordants in solutions and reacting with the alizarin, in order to precipitate the lakes, since the products thus obtained may not at all correspond to those obtained on the fibres.

It think it is also impossible to examine the change the oil has undergone by extracting Turkey red dyed goods by means of solvents, since if the modified fatty matter is insoluble in the solvent used, only the

unmodified or at all events slightly modified oil would be examined.

I have tried to put myself under the same conditions of working as those which take place in dye works, and yet in such a way that the lake should not be obtained on the cotton but on a material from which it could be easily removed, and I have tried a plan which until now has proved pretty successful, and by following which I hope to throw a little light both on the changes olive or castor undergo when exposed to heat, light and air in a similar way as it is done in practice.

I have employed ordinary window glass plates of different size on which I have applied a solution of prepared oil for Turkey red dyeing and I have exposed the same to the stove and air in the same way as by the manufacturing process, and followed the same through all the stages except the steaming, but I have boiled when dyeing, in order to form the red lake and finally soaped also at the boil.

The red lake clung to the glass in a much better way than could have been expected, and stood even boiling soap if it has not been made to react too long.

As it is I have only performed preliminary experiments, but I hope to obtain by this method some knowledge of the change which the oil undergoes when exposed to air, light and heat, and then to examine the combination which take place at each stage of the process.

It will be seen that that idea is to expose the oil to begin with in a very thin film on a large surface, just in a similar way as it is on cotton where the oil is very finely divided and spread on a very large surface.

The lakes I have obtained are not yet so bright as those which I can produce on cotton, but when I have had a little practice in glass dyeing I hope I shall be able to have as fine reds as it is possible to produce on cotton.

Porcelain plates can be substituted for glass ones, and I think silver sand or glass wool would form also very suitable materials for experimenting upon.

Turkey red dyeing is a very promising field of chemical research, and it will certainly repay any chemist to devote his time not only to try to find out the theory of the process, but also to try to bring further improvements in this branch of industry.

DISCUSSION.

The CHAIRMAN: Our thanks are certainly due to Mr. Sansone for his paper, which forms a third contribution on the subject of alizarin and its uses in dyeing, brought before this section. Mr. Levinstein led the way with his valuable essay on alizarin colours and their artificial production. Mr. Hummel followed with the application of the alizarin colours to woollen-dyeing, and Mr. Sansone appropriatly succeeds with the present paper on their application in cotton-dyeing. For us in Manchester, of course, the subject of cotton-dyeing is of principal interest. The possible formation of an oleic-alizarine-alumina lake, alluded to by Mr. Sansone, is of interest, and I would draw attention to the fact that the alumina in ordinary *red liquor* mordant exists there, as the so-called triacetate, or more properly, hex-acetate. By the action of heat alone acetic acid is set free from this compound, and the insoluble so-called *di-acetate* is precipitated. It would seem then probable that the oleic acid assists the alizarin to entirely displace acetic acid, so that even the di-acetate becomes decomposed, and finally and with increased ease a triple compound is formed with the alumina of a very stable and insoluble kind, as indicated in Mr. Sansone's equation.

ON A NEW METHOD FOR EFFECTING DISCHARGES ON FIBRE DYED WITH INDIGO.

BY C. A. FRANC.

THE offer of a medal by the Société Industrielle de Rouen for a new application of vanadium, together with a co-ordinate desire to facilitate the impression of discharges on fibre, dyed with indigo, contributed to the mutual solution of both these problems.

As every indigo dyer knows, the difficulties in effecting pure and regular discharges are not few. By pure discharges, I mean such discharges as will nowise impede the entry of other colours in those places where the colour has been entirely or partly destroyed. In many foreign (chiefly African) markets there is no mean demand for these styles, consisting of combinations of indigo with other colours, chiefly alizarin reds.

The methods for effecting these discharges are very limited. The only one in my recollection is the chromic acid discharge. The principle of its action depends on its power of oxidising indigo to the colourless product isatin. Now the next point for consideration is (1) whether or not this discharge is a pure one. (2) Does there remain on the fibre after this discharge has been effected any substance which would oppose the entry of alizarin colours? To this question my answer is "Yes." When this chromic acid delivers its oxygen to the indigo, converting it into the colourless product, it undergoes an action which, to say the least, finds some portion of it in the fibre as chromium trioxide, a powerful mordant, most objectionable, in fact, I may say fatal, to the entry of pure alizarin reds.

Another objection I beg to oppose to the use of chromic acid is its irregularity and inconsistency.

Another point upon which I beg to base my objection is the tendering effect it exercises upon cotton fibre.

The causes above named have induced me to look for another discharge free from the objections which I have submitted to your attention.

For this purpose I propose metavanadate of ammonia, a substance rendering at the present time considerable service in another branch of the same industry. I first took a mixture consisting of—

50grms. dark British gum dissolved in 50c.c. hot water.
10grms. chlorate soda.
5c.c. acetic acid 6T.
5grms. tartaric acid.
·05 metavanadate of ammonia.

With this mixture excellent results were obtained.

I now endeavoured to find the minimum quantity of vanadium necessary to effect the discharge. A mixture consisting of—

100grms. British gum,
10grms. tartaric acid,
20grms. chlorate soda,

was taken, and before printing, ·01grm. metavanadate of ammonia was added, and in spite of the small quantity I obtained good results.

These experiments I made at the Manchester School of Dyeing, under the supervision of Mr. Sansone, to whom I am in no small degree indebted for advice. I will now make a few observations as to the *modus agendi*.

It is a common practice amongst indigo dyers, after the final dip and exposure to air, to give the goods what is technically known as a souring. The vat I worked with was a "glucose or fermentation" vat. It was found that if the goods were not extremely well washed after the souring the fibre became rotten after ageing and steaming. I moreover found that if the goods were in any wise

damp before the discharge was printed they were considerably tendered. This tendering took place, curiously to state, not on the portions of the fibre where the colour was discharged, but on the blue portions where the discharge had never acted.

The same amount of vanadium I found to be effective for light and dark blues, but I found it advantageous in the case of very dark navy blues to add to the colour previously about 1grm. of oxalic acid for every 100grms. of gum.

This quantity must not be exceeded, as a larger one has the effect of rotting the fibre. The goods are aged and steamed just as in the case of aniline black. I obtained better results by soaping the whites.

DISCUSSION.

Mr. Sansone: As well known, chlorate of alumina, when applied on the fibre, if exposed to heat or steam, easily decomposes, forming free chloric acid, a powerful oxidiser. This chlorate of alumina has already been utilised by H. Schmid for forming oxycellulose on calico, and prints made by this means have the power of attracting aniline colours only on the spots where the chlorate of alumina has been applied, as the oxycelulose formed acts like a mordant. I thought of utilising this power of oxidation of the chlorate of alumina to produce white discharges on indigo dyed goods, but the whites obtained are not very clear. However, at the same time that the indigo is discharged, alumina is fixed on the fibre, and if the fabric is dyed with alizarin a red is at once obtained. The advantage of fixing alumina mordant on the fibre while the indigo is being at the same time discharged will be easily appreciated by those acquainted with the production of indigo printed and dyed goods. The only drawback found in the working of this process of discharging by means of chlorate of alumina is that the fabric is made rotten if exposed to the action of the steaming, but I believe that by ageing in the same way as for aniline black this tendering of the material could be avoided.

UNGUENTUM HYDRARGYRI, PILULA HYDRARGYRI, AND HYDRARGYRUM CUM CRETA: THEIR PREPARATION ON THE LARGE SCALE.

BY AD. SOMMER, PH.D.

The following is an abstract of the author's paper, which latter, at the request of the Chairman, was read before the meeting by Mr. Elborne.

Unguentum Hydrargyri.—In the preparation of this substance the author first draws attention to the fact that mercury is capable of more rapid extinction, or being brought to a finer state of subdivision, by prolonged agitation with such liquids as turpentine, olive oil, or resinous tinctures (*e.g.*, Tr. Tolu and Tr. Benzoin) than by the present mode of trituration with fat. For the preparation on the large scale of a commercial mercurial ointment, the author advocates the use of the following formula and method of manipulation :

Mercury	50lb.
Olive oil	4lb.
Resin	4lb.
Fresh beef tallow	42½lb.

Upon a solid board, which accurately fits into the frame of a sifting machine having a horizontal motion, are fastened by means of wires and wooden cross-pieces, two ordinary iron mercury flasks. Into each flask are poured 25lb. of mercury and 2lb. of olive oil. The plugs are then tightly screwed into the openings of the flasks, and the whole apparatus is laid in the aforesaid frame. The latter, which is attached to an eccentric crank, is then set in motion by connecting the latter by means of a belt and pulleys with the shafting of a steam motor, and allowed to be shaken for about eight hours. At the end of this time the mercury is in so fine a state of division that a magnifying glass with a power of ten diameters will show no globules of mercury. In the meantime, the beef suet is melted, and, after liquefaction, allowed to cool to about 50 C. The contents of the two flasks are then emptied into a capacious pan, and about one-fifth of the mixture of liquefied fat and resin added. This mixture is then vigorously stirred till it has become semi-solid, when another portion of the liquid fat, which, of course, by very little warmth, must be kept as near as possible to 50° C., is added to it. These additions and subsequent incorporations of liquid fat are continued until all of it has been added, observing the precaution never to make any new additions before the previous one with the mercurial mixture has cooled down to a semi-solid state. To ensure complete homogeneity the ointment while still warm is passed through an ordinary iron paint mill.

Pilula Hydrargyri.—For the preparation of this compound the author adopts a similar method for the extinction of the mercury, and gives the following formula :

Mercury	25lb.	Mixture for one mercury flask.
Glycerine	$2\frac{5\frac{1}{4}}{16}$lb.	
Water } each	9½fl. oz.	
Alcohol } each		
Powdered licorice-root	3oz.	

These ingredients are all placed in an iron mercury flask, which is shaken precisely in the same manner and by the machine described above under mercurial ointment. After eight hours of shaking, the mercury is found to be finely divided. The contents of the flask are then poured into a large dish, and honey, with energetic agitation added. When the mixture has become perfectly homogeneous, proper proportions of powdered rose leaves, marshmallow, and licorice-root, that are requisite for 75lb. of blue pill mass, are incorporated. The mass is further kneaded by means of a long wooden lever firmly attached to a wooden bench or table.

Hydrargyrum cum Creta.—Under this head the author describes in detail a well-known process, which consists of introducing the necessary ingredients, together with iron balls, into a large barrel, and rotating the latter on its axis by the aid of a steam motor for 10 hours, at the end of which time the mercury was found to be thoroughly incorporated.

After reading the paper, Mr. Elborne said that while no doubt the theory of the process for the extinction of the mercury introduced by the author was very good, he did not consider that British wholesale manufacturers of British Pharmacopœia mercurial ointment would be justified in adopting the author's formula, since the latter contained such extraneous substances as resin and olive oil; but for a "commercial" mercurial ointment, that is, one supposed to be of the same strength, but not prepared exactly according to the British Pharmacopœia process, the author's is probably a very good working formula. Mr. Elborne believed that all the unguentum hydrargyri, as at present prepared by the wholesale houses in this country, was made by trituration with heavy machinery; if, therefore, the author's process of extinction by agitation could be adapted to the British Pharmacopœia formula with any great saving of time and labour, he saw no reason why it should not be adopted. The mode of operating with the

British Pharmacopœia formula would then evidently consist in agitating the mercury with the lard, kept in the molten state by the application of heat; whether it would thus yield a satisfactory result he was not prepared to say. As regards the author's process for the extinction of mercury in the preparation of blue pill, it was certainly a novel one, the present mode of extinction adopted in the trade, he believed, being effected by means of a sort of drug mill in which the mercury was ground with honey. In reference to the mode of preparation suggested for the preparation of hydrargyrum cum creta, he believed it was a process already long adopted in this country, and one in which there was probably room for improvement.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: J. Campbell Brown.

Committee:

Ernest V. Bibby.	C. Symes.
Hudson A. Binney.	G. I. J. Wells.
Eustace Carey.	F. Hurter.
John Hargreaves.	H. Brunner.
E. Milner.	A. Norman Tate.
E. W. Parnell.	J. Affleck.

Local Sec.: E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The next meeting will be held on Wednesday evening, February 4th, 1885, when Mr. Watson Smith, F.C.S., will re-open the discussion on Mr. Norman Tate's paper read November 5th, 1884, and contribute a paper on the subject, entitled—"On a Course of Instruction in Chemical Technology, and the Difficulties experienced and to be overcome therein, in this Country."

Newcastle Section.

Chairman: J. C. Stevenson, M.P

Vice-Chairman: B. S. Proctor.

Auditor: N. H. Martin.

Committee:

P. P. Bedson.	John Pattinson.
G. T. France.	H. R. Procter.
C. H. Gimingham.	W. W. Proctor.
John Glover.	J. F. Stark.
A. S. Herschel.	T. W. Stuart.
John Morrison.	

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meetings, Session 1885, Jan. 8th, Feb. 5th, March 5th.

General Meeting held in the Lecture Theatre of the College of Science December 4, 1884.

MR. J. C. STEVENSON, M.P., IN THE CHAIR.

NOTES ON THE CHEMICAL AND METALLURGICAL INDUSTRIES OF THE UNITED STATES.

BY WILLIAM MARTYN, BOSTON, U.S.A.

Speaking first of chemical industries, and in general terms, we may say that there are five principal manufacturing districts. (1) Boston and Eastern district, (2) New York district, (3) Philadelphia, (4) Baltimore, and (5) Charleston, S.C. There are besides works at Buffalo, N.Y., Cleveland, O., Chicago, Ills., Memphis, Tenn., St. Louis, Miss., Wilmington, S.C., at three or four places on the Pacific coast, and a good many isolated works elsewhere.

In the Boston, New York, and Philadelphia districts a miscellaneous chemical business is done, including sulphuric, nitric, muriatic, and mixed acids, chemical fertilizers, dyers' chemicals, etc. In the Baltimore and Charleston districts chemical fertilizers are the sole products.

Sulphuric Acids.

There are about one hundred sulphuric works in the States. They are located all up and down the eastern coast, and at numerous places inland. They are of all capacities from the small works burning one ton of brimstone daily, to the large plant having an annual capacity of upwards of 20,000 tons pyrites. The production of acid during the current year will reach 395,000 tons oil of vitriol. The consumption of pyrites during the year will not fall far short of 75,000 tons; next year it will amount to at least 90,000 tons.

Brimstone

is usually burnt in the old fashioned burner with cast iron plate. The plate is commonly four feet by eight feet, but sometimes it is wider and often it is longer and narrower. Very often burners are found in the construction of which not a single firebrick has been used. The quality of the red bricks being such that substantial furnaces can be built without the use of the more expensive firebrick. Not unfrequently burners are seen built with solid brick beds. One would naturally expect that such a burner would get so hot in summer that sublimation would take place to an alarming extent, but by reducing the charge—which any way must be done for other reasons—this does not happen. Several Blair furnaces were put up some years ago, but all I think have been abandoned, the proper regulation of the admission of air being not quite so simple as was hoped.

Grate Burners.

Pyrites is burnt principally in the regular *grate burners* so well known on this side of the Atlantic. They are mostly a trifle larger than the average burner here, having from 22 to 25 square feet of area at the charging door. I expect shortly to build a block of burners in which I propose to adopt simple arrangements for mechanically shaking the grates and removing the cinders. With such burners I expect to reduce the labour cost for burning to one half the present cost. This where wages are so high as in America will be a not insignificant economy.

Shelf Burners

for small ore are worked with considerable success, and as American mines produce large quantities of rich and good "smalls" ore, the use of these burners is likely to extend. Smalls can be bought at from 3/- to 4/- per ton less than lump ore. *Spence's* mechanical furnace for smalls have been introduced in one or two works.

A furnace patented by Carter and Walker has been tried for burning smalls, but the success thus far attained has not been very encouraging.

There are three kinds of *pyrites* used in the States: Spanish, Canadian, and domestic. Speaking roundly 25,000 tons of each will be used this year. The Spanish ore is principally Rio Tinto, only a little Mason's and Tharsis being imported.

Canadian Ore.

The *Canadian ore* comes from Sherbrooke, just a few miles from the United States' boundary. There

are two mines: the Crown belonging to the Orford Copper and Sulphur Company, and the Albert, the property of G. H. Nichols and Co., of New York. The ore is sent over about 300 miles of railway to New London, Connecticut, where it is put on board vessels for New York. Canadian ore contains about 40 per cent. of sulphur, 3½ per cent. copper, 3 ounces of silver per ton, and 20 per cent. Silica.

Domestic Ores

are all very suitable for acid making, being rich in sulphur, containing only traces of arsenic or even none, and burning freely without clinkering, but they are mostly rather poor in copper, so that the cinder has thus far been of little value. They can be cheaply mined and transported into manufacturing centres. The principal mines are Milan at Milan, New Hampshire, 140 miles from Portland, Maine; the Davis, at Rowe, Massachusetts, 120 miles from Boston; and the Arminus mines at Victoria, Virginia, 40 miles from Richmond. There is a strong probability of the introduction of pyrites from Newfoundland in the coming spring. In fact some has already been imported.

Duty on Imported Pyrites.

There is a *duty on imported pyrites* containing not more than 3½ per cent. copper of 75 cents. per ton plus 2½ cents. per pound on the copper when the amount of the latter is over 2 per cent. During the present year only about 25 per cent. of the acid made has been produced from pyrites, but the proportion is rapidly increasing. 45 per cent. of the acid made is used for oil refining, 45 per cent. for the manufacture of fertilizers, and the remaining 10 is for miscellaneous purposes.

Glover Towers.

There are now a large number of *Glover Towers* at work, although many good acid makers still question the advisability of employing them. This is partly the result of the indifferent success attending the use of some of the faultily constructed towers first erected, and partly to the fact that the concentrating action of the tower is of no great benefit. At least 45 per cent. of the acid made is used at chamber acid strength, and as Glover tower acid is generally unsuitable for concentrating to 66° Baumé, the acid for this purpose is usually brought to 60° Baumé in lead pans mounted on top of the burners, or placed behind the platinum stills. One or two cases of Glover tower failing to act satisfactorily have been due to their having been placed too far away from the burners and in exposed situations. Several circular towers have been erected, but they are not preferred, as they are difficult to repair. The towers are usually packed with quartz rock from South Paris Maine.

While speaking of Glover tower I may mention that the plan of injecting the nitrous acid into the front chamber by a jet of steam has been quite extensively practiced, and in some cases with great success. At other works this mode of denitration has not given unmixed satisfaction. With a large absorbing space (so as to get the recovered nitre in a small quantity of rich nitrous acids) and watchful care, this plan admits of very good results so far as denitration is concerned, but the cooling action of the Glover tower is wanting (this with brimstone does not matter much) and the 60° Baumé acid for the absorbing tower has still to be concentrated in lead pans. Some very low Glover towers have recently been erected.

Chambers.

Coming now to the *chambers*, we find that there as here the extremes of very large and very small chambers have been tried. There is a greater incentive to building chambers with a large cross sectional area than there is here—lead and labour being so expensive, and the desire to keep capital account down much stronger. Chambers 28 to 30 feet wide and 25 feet high are not uncommon. I know of but one instance in which a width of 30 feet is exceeded, and in that case the width is 40 feet. The mode of carrying the top lead of this wide chamber is similar to that adopted at Widnes and perhaps elsewhere. Trussed girders are thrown across the chambers at a distance of about 20 feet apart, and bolted to these are iron loops into which slip the joists running longitudinally, to which the straps are nailed.

The chambers are usually carried 10 or 12 feet above the ground on wooden posts 8 or 10 inches square, placed on brick pillars 10 or 12 feet apart. The chamber frame is usually built quite strongly the uprights being generally 4 inches by 8 inches placed 4 feet apart, and the rails (or girts) 3 inches by 5 inches, and a like distance apart vertically. Yellow (or pitch) pine is the timber generally used for chamber frames, though not unfrequently the less-reliable spruce and hemlock are seen. The chamber *lead* is seldom stronger than 5lb. per square foot, though of late years the tendency is towards using 6lb. lead. I have even seen chambers built of 4lb. lead, and have known them to work for six or seven years (with brimstone), with little or no repairs, and 5lb. chambers may be seen that have been in constant use for 15 years without any overhauling. The hot summers and cold winters necessitate the complete roofing-in of the chambers. The roof is supported entirely independent of the chamber frame on posts standing in the passages.

At one works I am acquainted with a somewhat peculiar style of working chambers is in vogue. There are three sets of chambers, having in the aggregate a capacity of about 300,000 cubic feet. The residual gas from No. 1 set passes into No. 2, and the gas from the latter goes into No. 3. From the last chamber of No. 3 set the gas is taken to an absorbing tower. This seems like a partial carrying-out of a proposal once made by a works' manager, who mentioned it to me in confidence and asked my opinion of it. He proposed to take the residual gas from the last chamber of the set back to the first chamber, and in this way use his nitre over and over again without the trouble and expense of condensing and vapourising it again. I ought here to say that the results obtained at the above works are fully as good as those at neighbouring works.

At many works the pressure of the *steam* for the chambers is kept perfectly constant by means of an automatic regulator. The pressure at the boilers may vary ever so much, but the steam to the chambers remains perfectly steady. This obviates the necessity of setting apart of a boiler (or boilers) for the chambers alone and conduces very much to a regular chamber process. Whoever has run chambers with a good steam regulator will never do without one again.

Concentrating.

For *concentrating* to 66° B., the use of glass is almost entirely abandoned. Faure and Kessler's platinum dish and lead hood are in great favour, especially where pure water for cooling the hood is cheaply obtainable, or where pyrites acid is to be concentrated. The facility with which the dish can be cleaned out is a strong point in its favour where deposition of

solid particles from the acid take place. A considerable number of Johnson, Matthey and Company's new platinum stills are in use, and everywhere give satisfaction.

Quite recently an important innovation in concentrating apparatus has been introduced by Mr. Marinus Willott, of Newport, Rhode Island. It is designed principally with a view of employing in its construction *rolled* instead of the more expensive *hammered* platinum. The apparatus consists of a number of small boilers 3 feet long and 6 inches diameter placed above and behind one another over a fire-grate. The boilers are of rolled platinum $\frac{10}{1000}$ths of an inch thick, and are connected with each other at alternate ends by means of elbow pipes and loose sleeve joints. One boiler is allowed for each 2 tons of strong acid daily. The cost of the apparatus is said to be only about one-half that of a Faure and Kessler still, of similar capacity. It is claimed that the loss of platinum is not so great as with any existing apparatus, and that the consumption of fuel is less, but it is difficult to see what there is to base such claims upon. The apparatus has been in use almost twelve months, at works with which the inventor is not in any way connected, and has given satisfaction. The weak point about the arrangement seems to me to be the soldered joints all round each end of the boilers.

During the past two years a good deal of 66° B. acid has been concentrated in iron vessels at a works in New Jersey.

The prices of material (in quantity) in New York, Boston and Philadelphia, are about as follows :—

	£	s.	d.	
Yellow (pitch) pine	0	1	0	per cubic foot.
Spruce	0	0	7½	,, ,, ,,
Red-bricks (21 per cbc. ft.)	1	9	0	,, ,, ,,
Fire-bricks	6	0	0	,, ,, ,,
Sheet Lead	21	0	0	per ton.
Pyrites	1	5	0	,, (2240 lbs.)
Nitre	0	10	6	per cwt.
Coal	0	16	0	per ton.

Wages run about as follows :—

Carpenters	7/- to 10/-	per day of 10 hours.
Bricklayers	13/-	,, ,,
Lead Burners	16/- to 22/-	,, ,,
Labourers	5/- to 7/-	,, ,,
Burnermen	7/- to 8/6	per shift.

Nitric and Muriatic Acids.

These are made principally in the New York and Boston districts. The cast iron cylinders used for the distillation, are usually about 4 feet in diameter and 9 feet long. The metal is 1⅝ to 2 inches thick. The fire-grate is 3ft. 3in. long and 15 inches wide ; it is 3ft. 6in. below the bottom of the cylinder. The charge is usually 800 lbs. nitre, or 1,100 lbs. salt. The cylinders are either worked intermittently—in which case the cylinders are working one day and cooling down the next, and the cylinder cake is removed in the solid state—or else continuously, and the acid sulphate is run off soft. About five per cent. more acid is generally used when the latter mode of working is adopted, but it is mostly preferred to sacrifice that amount of acid and work the retorts to their full capacity excepting where the escape of acid fumes from the liquid sulphate would lead to trouble with the neighbours.

The receivers are of earthenware and are mostly made in Philadelphia ; they are from 30 to 35 gallons capacity. The carboys in which the acid is shipped are packed in square wooden boxes.

Mixed Acid.

A good deal of this is made in the vicinity of Boston, New York and Philadelphia, for the nitrification of glycerine in the manufacture of dynamite and blasting powders. It consists of a mixture of two parts strongest nitric acid, and one part of 66° B. sulphuric acid. It is sent to the dynamite works in the sheet iron drums in which glycerine is imported

Tin Crystals.

This is an important manufacture carried on in the neighbourhood of New York and Boston. The crystals are used in the dyeing establishments in the vicinty. Feathered tin is dissolved in muriatic acid in copper pans heated by a coal fire and the chloride of tin solution is crystallised in earthenware dishes two feet in diameter. A quantity of single and double muriates and of oxychloride of tin are also made.

Stannate and Silicate of Soda and Iron Salts.

These are made near New York, Boston and Philadelphia. A good deal of the two soda salts is imported.

Glaubers Salts.

These are made, though not in a very large quantity, in the vicinity of Boston and elsewhere. Nitre- and cylinder-cakes are roasted to expel the excess of sulphuric acid, the neutral sulphate passed through a pair of Cornish rolls and dissolved in hot water, the iron is then precipitated with milk of lime, and the liquor, after settling, is run into lead-lined wooden coolers to crystallise.

Bicarbonate of Soda.

Almost the whole of the bicarbonate used in the country is prepared at home—judging from the extent to which baking powders are used the amount must be not inconsiderable.

Soda Crystals.

The American name for these is sal soda. Formerly all the crystals used were imported from this country, but of late years a considerable quantity has been made at home from imported soda ash. I think there are good reasons for believing that this branch of manufacture is likely to extend. The duty of 23 shillings per ton and the ocean freight on 12 cwts. of water per ton crystals, form a very good protection, but the very hot weather of an American summer is a great drawback.

Soda Ash.

Up till quite recently this has not been made in any quantity. For a number of years the Pennsylvania Salt Manufacturing Company have made a little of both ash and caustic from cryolite, at their works in Natrona, Pennsylvania, and within the last twelve months a small quantity of Le Blanc soda for local use has been made from cylinder cake at a large print works on the Hudson river, New York. But the establishment of the Le Blanc process in its entirety in any part of the States seems highly improbable, notwithstanding the protection afforded by ocean freight and a duty of 23s. per ton on ash, and £2 6s. per ton on caustic. Coal and labour are both too dear. Two ammonia-soda works are now in operation at Geddes and Syracuse, in New York State—two salt-producing centres. There are plentiful supplies of strong brine in both New York and Michigan, the two States together producing about 600,000 tons of salt yearly. Little rock salt is mined at present. Ordinary white salt is worth about 21s. per ton in New York.

Commercial Fertilisers.

This is the name given to chemical manures. They are made at all the chemical centres on the Atlantic seaboard, at Buffalo, New Jersey; Cleveland, Ohio; Chicago, Illinois; in Tennessee, and at isolated works in nearly every State in the Union. The quantity annually made is about 900,000 tons, and is constantly on the increase. Two-thirds of this is made in the Boston, Charleston, New York, and Baltimore districts; Baltimore being at the head of any single district.

The principal phosphoric material is the phosphate rock of South Carolina, 60 per cent. of the phosphoric acid in manufactured goods being derived from this material. Of the remaining 40 per cent., Navassa phosphate rock and bones are the chief sources. The supply of potash is imported from Germany.

For ammoniates, nitrate of soda and all kinds of animal refuse, including a large quantity of fish, are used. Within the last two or three years quite a large quantity of cotton seed has been used as an ammoniate, both by manufacturers and by the cotton growers themselves in the Southern States. Many of the latter have taken to burying plain superphosphate and potash salts, and mixing with them their own crushed cotton seed, the oil of which has been extracted at one of the numerous works erected for the purpose. In this way quite a revolution is going on in the fertiliser trade of the south.

The South Carolina rock is generally delivered at the works in pieces the size of hens' eggs. It is first fed into a grinder, consisting of a semi-cylindrical cage in which revolves a strong shaft carrying wormlike steel blades. In this grinder the rock is reduced to the size of Barcelona nuts, in which state it goes to the burrs. These are usually under runners, and a pair three feet six inches diameter reduces 14 to 20 hundredweight of land rock per hour to 50 mesh. Not much more than half that quantity of river rock can be put through, and the hard kernels play havoc with the burrs.

Canadian apatite is not in great favour with American manufacturers. They find it costly to grind, and difficult to get the acid to act on all the particles, and the strong evolution of hydrofluoric acid is decidedly objectionable.

The *acidulation* of the ground rock is effected in horizontal dishes, which revolve round a vertical axis. The pan of the mixer is eight to nine feet in diameter, and 15 inches deep. The stirring is effected by means of a fixed blade. About 2,500 to 3,000 lbs. of rock are put into the mixer at each operation, and six to 10 mixings are made per hour.

The acid is generally used of a strength of about 47° Beaume, the extremes of strength being 46 and 53. After acidulation, the ammoniates (excepting nitrate of soda) are added in the mixer. A central plug, about nine inches diameter, is then raised, the discharging scraper lowered, and the contents of the pan emptied into the bins below.

Several improvements have lately been introduced, one is the *Sturtevant mill*, to do the work of grinders and burrstones, and another is the *Blake system* of fine crushing. Neither have yet been in use long enough to establish the claims made for them. A third innovation is the combining of the milling and mixing into one operation. Friends of mine who have adopted this style of working are pleased with it.

Some manufacture what they call *special fertilisers*; that is fertilisers specially adapted for different crops. Thus they have one fertiliser for potatoes, another for wheat, another for Indian corn, and so on. But the great majority of manufacturers make only standard fertilisers, containing about

10 per cent. available phosphoric acid,
$2\frac{1}{4}$,, ammonia,
$2\frac{1}{2}$,, potash.

In many States the law compels makers of fertilisers to mark on the outside of the package the percentage of the fertilising constituents.

Bichromate of Potash

is prepared on an extensive scale at a works in Baltimore, Maryland.

Acetic Acid.

This is prepared near New York, in Philadelphia, and elsewhere, from the distillation of wood.

Blue and Green Vitriols.

These are both prepared on an extensive scale at different places.

Metallurgical Industries.

The United States now stand in the front rank of base as of precious metal producers. In the production of iron she has long taken a leading place. The present annual production of pig is about five million tons: Pennsylvania is credited with 50 per cent. of this, and New York, Illinois, and Ohio with about 10 per cent. respectively. Of *Bessemer steel* the annual output is about $1\frac{3}{4}$ million tons. Most American pigs contain appreciable quantities of phosphorus, so that large quantities of Bessemer pig have still to be imported. The presence of phosphorus in the iron enables founders to turn out very fine castings. Even furnace castings and such rough work as that will compare very favourably with the best work we are accustomed to see in chemical works at least, on this side the Atlantic.

Coming now to

Copper,

we find that whereas ten years ago the output of copper outside of Lake—of which some 15,000 tons were produced annually—was quite insignificant. Now the production of copper from sulphides, oxides, and carbonates is some 20,000 tons, and the total output of copper is 50,000 tons per annum. The exports of copper—in the form of argentiferous ores and mattes—during the current year will be more than 10,000 tons.

The leading copper district is still that of *Lake Superior*. The metal, as is well known, occurs in the native state, and is of exceptional purity. It has been mined for about 40 years. At first principally the mass copper—large masses of pure copper—were worked, but the cost of cutting up and handling this was so great that investments in Lake mining were at first not very profitable. Now the copper is principally produced from ore carrying two to nine per cent. of the native metal. The ore from the Calumet and Hecla mines—from which are extracted 60 per cent. of the annual output of Lake copper, and 35 per cent. of that of the whole country—averages $4\frac{1}{2}$ per cent. The ore is crushed and concentrated mechanically to about 70 per cent. copper, and these concentrates are then shipped to the smelting works at Hancock and Detroit. After refining, the ingot copper is shipped along Lake Erie to Buffalo, N.Y., whence it is sent by rail to New York and eastern markets.

The next most important copper district is *Arizona Territory*, from which comes 20 per cent. of the annual output of the States. The ores are oxides

and carbonates, carrying (very frequently) about 15 per cent. of copper. They are usually concentrated by mechanical means to say 25 per cent. copper, and are then smelted—with siliceous fluxes—in blast furnaces for the production of coarse copper, containing say 98 per cent. metal. This is shipped to New York and Baltimore to be refined. Coke for smelting is brought from Cardiff, *via* San Francisco, or from Trinidad, Colorado. It costs at the mine £4 to £12 per ton.

Next in importance comes *Montana Territory*, from which comes 10 per cent. of the total production. The mines and smelting works are all in the neighbourhood of Butte City. The ores are all sulphides, and are invariably argentiferous. The produce varies from eight to 50 per cent., the average being about 10 per cent., and the silver is usually about one ounce per unit of copper. The ores are nearly all largely contaminated with arsenic. The poorer ores are smelted to a 70 per cent. matte, which together with the richer ores, is shipped East to be refined, much of it ultimately finding its way to England.

New Mexico and *Wyoming* Territories are quickly coming to the front as copper producers, and there are likely to be rapid developments there within the next two or three years.

There are five copper smelting and refining establishments on the Atlantic seaboard. The works are located as follows:—

Ansonia, Connecticut.	Ansonia Copper Company.
Taunton, Mass.	Crocker, Brothers.
Bergenport, New Jersey.	Orford Copper and Sulphur Co.
Elizabeth, New Jersey.	New Jersey Extraction Works, Limited.
Baltimore, Md.	Pope, Cole, and Co.

There are two wet extraction plants for treating pyrites cinders—one at Elizabeth, New Jersey, and one at Natrona, Pennsylvania.

In regard to the furnaces used for copper smelting in America, we may say that reverberatory and cupola furnaces are both extensively used, often side by side. For the rich oxides and carbonates in Arizona cupola furnaces are exclusively used. For the sulphide ores of Montana reverberatory furnaces are generally preferred for silicious ores, and cupolas for basic ones. The reverberatory furnaces are (sometimes at least) in this case fired with wood. For smelting the Lake Superior ores reverberatories are used, and cupolas for cleaning the poor slags. The works on the Atlantic coast use both types of furnace.

Great attention has been paid to the construction and working of *cupola furnaces*. Those now generally used are water-jacket furnaces, the construction of which several engineering firms make a specialty of. They are made of circular and of rectangular horizontal section, the larger ones being of the latter shape. They have a capacity of from 20 to 60 tons daily or even more. Where fuel, fire-bricks, etc, are very expensive, as in some of the mining districts of the Far West, this type of furnace is more economical than any other.

At the Orford Copper and Sulphur Company's works Bergenport, New Jersey, there are very large cupola furnaces (not water-jacketed) having a daily capacity of almost 200 tons. At these works the plan of working with *outside wells* has been very succesfully introduced. The melted mixture of metal and slag runs out of the furnace as quickly as melted into a moveable well placed in front of the furnace. This well is about 6 feet long, 18 inches wide and 18 inches deep outside. It is formed of an outer shell of boiler plate with fire-brick lining. Across the middle a fire-brick partition is formed which reaches to within two or three inches of the bottom and divides the well into two compartments, each about 2′ 3″ long, 14″ wide and 14″ deep. The molten mixture runs into one compartment near the central partition. The slag flows off at the other end of the compartment in a continuous stream while the matte settles down, and passing under the brick partition into the next compartment is run off into suitable moulds. The works of this company are quite extensive, having a capacity of 300 tons refined copper weekly. They employ very large reverberatories for roasting their white metal and for refining. Quite recently they have erected plant for extracting the silver from argentiferous copper mattes on a large scale.

In *buying copper ores* and furnace products the copper percentage is always determined by electrolytic precipitation from a slightly acid solution. From this 1·3 per cent. is deducted for smelters' allowance. The price is generally fixed at so many cents per pound of copper (say the current or prospective value of fine copper) less so many cents per pound for smelting and refining. This last figure varies of course with the produce of the ore or matte, and likewise with the nature of the ore. The ingots are usually made very much smaller there than here.

Lead.

The production of lead in the United States now almost equals that of England (including foreign lead smelted here), being nearly 140,000 tons per year. The imports have dwindled into comparative insignificance. The leading lead state is *Colorado*, turning out, as she does, one half the total annual production of the States. More than two thirds of the Colorado lead is smelted in Leadville. There are also very extensive works at Denver and at Peublo. The ores contain 10 to 20 per cent. lead and about 20 ounces silver per ton. Water-jacket cupola furnaces are used for smelting, Trinidad (Colorado) coke being used for fuel. The coke costs about £2 10*s*. per ton delivered. Iron ore, limestone, etc. are used as fluxes. For roasting reverberatory furnaces, 40 feet long, are used, fired with wood or coal.

For working cupola furnaces at high altitudes—as at Leadville—more fuel is required than at places nearer the sea level. This difference is said to amount to as much as 25 per cent. The loss of lead in smelting is about 10 per cent., but is frequently more.

The next most important lead district is the territory of *Utah*. She produces one fourth of the total annual out-put of the States. The ore mined is very rich, containing over 30 per cent. lead, and 30 ounces silver per ton. Its richness enables it to hold its own, notwithstanding its great inacessibility to markets and to fuel. It is partly smelted in Salt Lake City, and partly in Chicago, Illinois.

Missouri and Kansas form the next important lead district. The ores contain no silver, but they are able to hold their own in competition with argentiferous ores, owing to their nearness to markets and cheap fuel.

Nevada was, up till a few years ago, the principal producer of lead, but the out-put is now not more than 30 per cent what it used to be.

Zinc.

Zinc is produced to the extent of about 30,000 tons yearly. Upwards of 10,000 tons a year are imported. The ores are raised in New Jersey, Pennsylvania, Wisconsin, Illinois, Tennessee, Missouri and Kansas.

They are smelted at Jersey City, Bergenport and Newark, New Jersey; Bethlehem, Pa.; La Salle and Peru, Illinois; St. Louis and Rich Hill, Missouri; and at Ure City, Pittsburg and Joplin, Kansas.

Fifty per cent. of the smelting is done in Illinois. At one large works in that state the sulphurous fumes, produced in the preliminary roasting of the ores, are

used for sulphuric acid making. The ore is roasted in a furnace having six beds, along which it is moved mechanically.

The kind of furnaces, used for the distillation, are principally modifications of the Belgian furnace. The application of Siemens' regenerative furnace has been adopted in some works.

Meeting held Jan. 8th, 1884.

MR. B. S. PROCTOR IN THE CHAIR

DISCUSSION ON DR. DIVERS' PAPER ON THE RECOVERY OF SULPHUR FROM ALKALI WASTE, READ AT THE NOVEMBER MEETING.

MR. JOHN PATTINSON: I think the paper is interesting, and contains a number of new facts in chemical science, which the author appears to make out very clearly. It is valuable, inasmuch as it will prevent future investigators from going over the same ground again, although its practical application is not at present very obvious. Indeed, in the present state of the Leblanc soda process there seems no prospect of success for any process of sulphur-recovery depending on the oxidation of the waste, and alkali makers will not have much heart to experiment with such processes.

Mr. F. S. NEWALL: Although, as Mr. Pattinson says, there may be no prospect of success for *oxidation processes* of sulphur recovery, yet I think that the question of making use of the sulphur is one which every alkali maker ought to take up. It is just by attending to points like these that the Leblanc process can continue to hold its own against the ammonia-soda process. After all, the difficulties in the way are not so very great; and if one or two alkali makers were to stick to the Schaffner-Helbig process as Mr. Chance has done at Birmingham, and as we are now doing at Washington, I think a satisfactory solution of the problem would soon be arrived at. I do not wish to make any numerical statements as yet, because the process is still in its infancy; but we have had it continuously at work for more than a year now with very satisfactory results, and I hope that a longer experience of the process will enable us to state those results in the form of well-ascertained and reliable numerical facts.

REDUCING ACTION OF COKE ON NITRIC ACID DISSOLVED IN SULPHURIC ACID.

BY G. LUNGE.

SOME time ago Naef and myself (in a paper on the reactions in the sulphuric acid chambers, "Chemische Industrie," January, 1884; the original at length has been abstracted in the "Journal of the Society of Chemical Industry, December, 1884, p. 633,) called attention to the remarkable fact that the "nitrous vitriol" of the Gay-Lussac towers, except in a totally abnormal state of the chambers, never contains any nitrogen compound except nitrous acid (of course in the state of "chamber crystals" or nitrosyl-sulphuric acid), even if the gases on entering the tower had contained considerable quantities of nitrogen tetroxide, which ought to have produced nitric acid along with nitrous acid. This fact had been previously noticed by myself and by several other observers, but it had never been established before with such certainty, and been placed beyond any doubt by contemporaneous observations of the gases and the vitrol, with the aid of the most improved analytical methods. Some of the previous observers had explained it by the assumption that the sulphuric acid of the Gay-Lussac tower, when acting on a mixture of N_2O_3 and N_2O_4, absorbs only the former and allows the latter to escape. My direct experiments (comp. "Journal of the Society of Chemical Industry," 1882, p. 107) had proved that explanation to be untenable, by showing that sulphuric acid, even at a specific gravity of 1·78, easily and completely absorbs N_2O_4. Still it *might* be thought that in gaseous mixtures, containing extremely small quantities of nitrogen compounds, the absorbing action of sulphuric acid on N_2O_4 might be less than on N_2O_3, although I must confess that I could not see any reasonable explanation of such a state of things. Unfortunately, it is hardly possible to work on a laboratory scale with a gaseous mixture containing as small a quantity of nitrogen compounds as chamber exit gases, so that I had to renounce a direct solution of this question. But it had been pointed out in the paper, quoted at the outset, that the nitric acid produced from the nitrogen tetroxide might possibly be reduced to trioxide by the action of the coke packing of the Gay-Lussac tower, and this I have now proved to be the case by experiments made in my laboratory by Mr. E. Schnyder.

Pure concentrated sulphuric acid was mixed with a little pure nitric acid, and it was established by several analyses (according to Peligot's method as modified by myself) that the mixture contained 0·037273 grams HNO_3 in 1 cubic centimetre, which corresponds to the nitrogen contained in strong nitrous vitriol. The mixture had no action on potassium permanganate. Several portions of 50c.c. of this mixture were brought into contact with 20 grams each of clean, ground-up coke in air-tight flasks and kept for different periods and at different temperatures. At the end of the experiments the acid, which now smelt strongly of nitrous compounds, was several times filtered through glass-wool to remove any particles of coke-dust which might have affected the potassium permanganate on titration. The clear acid was put into a burette and slowly run into a dilute solution of potassium permanganate of known strength, heated to 40° C., till the colour was discharged. Thus the quantity of nitrogen trioxide formed could be found, and it has been calculated in the following table in per cent. of the nitric acid originally present.

	Period of Action.	Temperature.	Nitric Acid reduced to N_2O_3, per cent.
1.	$2\frac{1}{2}$ days	20°C.	13·41
2.	8 ,,	20°C.	64·78
3.	1 hour	30°C.	16·85
4.	$4\frac{1}{2}$ hours	38–40°C.	96·71

Hence it is proved that the nitric acid dissolved in sulphuric acid, in contact with coke, is reduced to nitrogen trioxide, slowly at the ordinary temperature, but quickly and practically completely at a slightly elevated temperature, such as usually exists in the Gay-Lussac tower. Whether the reduction takes place directly by the organic substance of the coke, or by sulphurous acid produced by the action of the coke on sulphuric acid, the experiment could not decide.

SOLUBILITY OF CALCIUM SULPHATE IN SOLUTIONS OF SODIUM AND CALCIUM CHLORIDE AND IN DILUTE HYDROCHLORIC ACID.

BY G. LUNGE.

IT is well known that calcium sulphate is more easily soluble in certain saline solutions (such as potassium nitrate and sodium chloride), and in

hydrochloric acid than in water—probably owing to mutual decompositions, as seems proved by the following experiments, according to which calcium chloride, which cannot decompose calcium sulphate, *lowers* the solubility of the latter with increasing concentration. Since quantitative data on the above action seem to be still wanting, I had a few of the more important cases investigated by one of my students, Mr. A. Steiner, viz., the solubility of calcium sulphate in differently concentrated solutions of sodium and calcium chloride and hydrochloric acid, both at the ordinary temperature and at the boiling point.

For the experiments at the ordinary temperature portions of 200c.c. each of the solutions in question, perfectly free from sulphates, were brought into contact with an excess of freshly precipitated calcium sulphate, entirely free from other sulphates, for a space of three weeks, agitating three times a day. As the experiments were made in summer, and the flasks were kept from sun-light, there would be no very great variations of temperature; the final temperature was always noticed. At the end the liquids were poured through dry filters; the sulphuric acid in the filtrate was estimated by barium chloride and calculated as calcium sulphate.

In the experiments at boiling heat the liquids were boiled with an excess of calcium sulphate in flasks provided with a reflux-cooler for half-an-hour, observing the temperature; they were then poured through a dry filter contained in a hot-water funnel, and the filtrate was allowed to cool down in closed flasks so that no sensible change of concentration took place. In the case of NaCl and $CaCl_2$ the solutions on cooling did not become turbid, so that the estimation of $CaSO_4$ could be proceeded with directly; but in the case of HCl a good deal of gypsum crystallized out on cooling; hence a portion of the liquid was taken out whilst hot by means of a pipette whose contents had been estimated at the same temperature, and was diluted with water for the purpose of analysing it.

From the experimental results, the following table of the solubility of calcium sulphate has been calculated.

Temperature	Liquid containing per cent. of	100c.c. dissolve $CaSO_4$
21·5°C.	3·53 NaCl	0·5115 grms.
19·5 ,,	7·35 ,,	0·6429 ,,
21·0 ,,	11·12 ,,	0·7215 ,,
18·0 ,,	14·18 ,,	0·7340 ,,
17·5 ,,	17·46 ,,	0·7369 ,,
101·0 ,,	3·53 ,,	0·4891 ,,
102·5 ,,	14·18 ,,	0·6248 ,,
103·0 ,,	17·46 ,,	0·6299 ,,
23·0 ,,	3·54 $CaCl_2$	0·1225 ,,
24·0 ,,	6·91 ,,	0·0963 ,,
25·0 ,,	10·36 ,,	0·0886 ,,
25·0 ,,	15·90 ,,	0·0734 ,,
25·0 ,,	16·91 ,,	0·0702 ,,
101·0 ,,	3·54 ,,	0·1370 ,,
102·5 ,,	10·36 ,,	0·1426 ,,
103·5 ,,	16·91 ,,	0·1301 ,,
25·0 ,,	0·77 HCl	0·6405 ,,
25·0 ,,	1·56 ,,	0·8821 ,,
25·0 ,,	3·06 ,,	1·2639 ,,
25·0 ,,	4·70 ,,	1·5342 ,,
25·0 ,,	6·12 ,,	1·6539 ,,
101·0 ,,	0·77 ,,	1·1209 ,,
102·0 ,,	3·06 ,,	3·1780 ,,
103·0 ,,	6·12 ,,	4·6902 ,,

Hence the solubility of $CaSO_4$ in solutions of NaCl increases with the percentage of NaCl, but diminishes with a higher temperature; $CaCl_2$ diminishes the solubility of $CaSO_4$ at the ordinary temperature the more it is concentrated, whilst at the boiling point the concentration is immaterial. HCl considerably increases the quantity of $CaSO_4$ dissolved, both with an increase of concentration and of temperature.

ACTION OF CHLORATES ON METALLIC EVAPORATING VESSELS.

BY G. LUNGE.

EVERY manufacturer of chlorate of potash is aware that his boiling-down pans are acted upon by the liquors, even when they are free from chlorine or hypochlorite. The clear liquor becomes turbid during the evaporation, and in the case of iron pans deposits a red muddy precipitate. In the case of lead the formation of a mud is not so conspicuous; evidently the lead oxide originally formed decomposes with potassium chloride into caustic potash and lead chloride, at least partially. Usually it is assumed that lead is less acted upon than iron, but the latter is often preferred as being more durable. It seems to be an open question whether cast iron or wrought iron is more suitable for such boiling-down pans; the latter are cheaper for large sizes and more easily repaired than cast-iron pans, but are more quickly acted upon by the liquors.

Since no positive experiments have been published concerning the action of chlorate liquors upon the pans, I have caused such to be made by Mr. A. Deggeler in the following manner.

We provided short pieces of cast-iron, wrought-iron, and lead tubing whose surface could be accurately computed. These were separately immersed for seven hours in boiling solutions—First, of pure potassium chlorate, containing 6·03 per cent. $KClO_3$ by weight; second, of potassium chlorate, containing 25·0 per cent.; third, of calcium chlorate and calcium chloride, obtained as usual by passing chlorine through milk of lime and boiling till no more free chlorine or hypochlorite was present; this solution was diluted to spec. grav. 1·16. During the treatment the loss by evaporation was always made good by adding fresh water; in the end the solution was filtered from the metal and the precipitate formed, and the latter was well washed.

The action which had taken place could be easily determined in the two first cases by estimating the chloride formed, for the potassium chlorate employed was entirely free from chloride, and according to previous experiments made in my laboratory solutions of potassium chlorate lose no oxygen even by prolonged boiling. Of course it would have been very acceptable if the results could have been checked by estimating the loss of weight of the metal, but this could not be done since part of the oxides formed closely adhered to the metal, whilst another part floated about in the liquor. Neither was it practicable to estimate the increase of weight of the metal by the oxide formed, and in the case of lead this would have led to nothing at all, because some $PbCl_2$ is formed. But in this case as well as in that of iron it was sufficient to estimate the chloride formed, since it is evidently indifferent whether the chloride present is that of K or of Pb, and the latter remains dissolved in the large bulk of liquid.

In the third case, that of a mixed solution of calcium chlorate and chloride, only part of the liquid could be taken for analysis. The quantity of chloride present was accurately estimated both before and after the experiment, and the amount of action calculated from the increase of chloride.

The quantity of chloride formed served for calculating (*a*) the quantity of chlorate decomposed which in the following table is put as $KClO_3$ by that of the metal dissolved, with the, no doubt very nearly correct, assumption that the compounds formed are Fe_2O_3 and PbO. The results, each of which is the average of at least two well-agreeing experiments,

are all reduced to 1 square metre of metallic surface.

Results of seven hours' boiling of solutions of :

	Metal oxidized grams.	$KClO_3$ decomposed grams.
I. Potassium chlorate 6·03 per cent. upon 1 sq. metre of cast iron..	11·25	12·26
„ 1 „ „ wrought iron	20·10	21·96
„ 1 „ „ lead	61·30	12·76
II. Potassium chlorate 25·0 per cent. upon 1 sq. metre of cast iron..	21·59	26·90
„ 1 „ „ wrought iron	11·90	18·91
„ 1 „ „ lead	151·12	29·81
III. Calcium chlorate and chloride spec. grav. 1·16 upon 1 sq. metre of cast iron	85·00	92·65
upon 1 sq. mt. of wrought iron	95·00	103·55
„ 1 „ „ lead	437·70	86·31

From this the following conclusions may be drawn :—

1. All metals employed are acted upon by the boiling liquors treated therein, more so by concentrated than by dilute solutions of potassium chlorate, and most of all by the mixed solution of calcium chlorate and chloride formed in manufacturing. Since the latter solution is boiled down in practice, much further than the strength employed in the above experiment, viz., to about spec. grav. 1·37, its action upon the metals will thus be much stronger than in the series III.

2. The weight of metal dissolved is always smallest in the case of cast iron, by far the greatest in the case of lead, wrought iron holding a middle place, but being in the series III. not much worse than cast iron. If we consider that the calculations from the chloride formed are made from pure iron, but that cast iron only contains 90 to 93 per cent. of such, the difference between cast and wrought iron is still further reduced.

3. The weight of chlorate destroyed does not differ very materially whether cast iron or lead are employed; in the series I. and II. it is slightly in favour of the former, in the series III. of the latter.

4. Since in any case the quantity of chlorate destroyed is not essentially less in the case of lead pans than in that of iron pans, but the loss of metal dissolved (as well as the cost of firing and repairs) is much greater with lead than with iron, boiling-down pans made of iron are preferable to leaden ones. According to the practically most important series of experiments, number III., there is no essential difference in respect of action between cast and wrought iron.

HOW SELENIUM GETS INTO HYDROCHLORIC ACID.

BY EDWARD DIVERS, M.D.

Professor of Chemistry in the Imperial College of Engineering, Tokio, Japan.

KIENLEN appears to have been the first to draw attention* to the occurrence of selenium in commercial hydrochloric acid. It has been also the subject of notices by Hart† and Davies.‡

The selenium comes, of course, from the sulphuric acid used in making the hydrochloric acid, and is to be seen, partly or wholly, in the elemental state, suspended in the hydrochloric acid solution. But it is wrong to suppose that selenium volatilises in this state during the treatment of the salt with the seleniferous sulphuric acid, and that it then comes over when the heat in the decomposing pan has increased to dull redness (Kienlen).

* *Bul. Soc. Chim.* 1882; *Ch. News*, 46, 66.
† *Ch. News*, 48, 193.
‡ *Z. S. Ch. Ind.*, 2, 157.

Selenium comes off with the first portions of hydrochloric acid gas, and while the mixture is therefore relatively cold, and would still do so even if the mixture were colder than in practice it is. The escaping gas is itself apparently colourless, but it colours a concentrated solution of hydrochloric acid yellow. With water both the gas and the yellow solution give a red precipitate of selenium.

The selenium distils over in the form of selenium selenochloride, Se_2Cl_2, and this decomposes when it meets water, into elemental selenium, selenious acid, and hydrochloric acid. Selenium selenochloride is hardly volatile at ordinary temperatures by itself, but it rises readily with hydrochloric acid gas, probably as a colourless compound, $HClSe.SeCl_2$. It was this volatilisation of selenium which led me to detect selenium in Japanese sulphuric acid, before Kienlen, or anyone else, so far as I know, had published any statement of its occurrence in some commercial hydrochloric acids. My former pupil, Mr. Shimosé, M.E., has published in the *Chemical News* his observation of the liability to loss of selenium in analysis by the volatilisation of selenium selenochloride from a hydrochloric acid solution, when selenium has been dissolved in that acid with the help of bromine used too sparingly.

When the selenium is in the sulphuric acid in the form of dioxide, there seems to be present always enough reducing matter—bromides, sulphur dioxide, the iron of the pan, etc.—to cause its reduction (Hart). When it is in the form in which it dissolves in sulphuric acid, that is of sulphoxide, $SeSO_3$, as well as after its reduction from its oxide, it reacts at once with hydrochloric acid in the manner described by Mr. Shimosé and myself,§ and forms the selenium selenochloride, which then volatilises :—

$$2SeSO_3 + 2ClH = Se_2Cl_2 + SO_4H_2 + SO_2$$

Where the selenium selenochloride is acted upon by water in absence of sulphur dioxide, part of the selenium as already mentioned remains in solution :—

$$2Se_2Cl_2 + 3OH_2 = 3Se + 4ClH + SeO_3H_2.$$

But in presence of sufficient sulphur dioxide all the selenium becomes free :—

$$Se_2Cl_2 + SO_2 + 2OH_2 = SO_4H_2 + 2ClH + 2Se$$

Even where, as is more usual, the selenium selenochloride has been formed by the combined action of hydrochloric and sulphuric acids as shown by the uppermost of the preceding equations, the selenium chloride distilling over condenses so much quicker than the sulphur dioxide, simultaneously formed and present with it, so as to give at first a yellow solution, if only very little water, or the strongest hydrochloric acid is present. Thus the selenium comes over with the first portions of gas from a batch, and not with the last portions as hitherto supposed.

The remainder of the Meeting was devoted to the exhibition of novelties in apparatus, etc., and the reading of short notes.

Mr. LARKIN, of the St. Bede Chemical Company, exhibited and described plans of his new mechanical decomposing furnace now in use at the St. Bede Works at Jarrow. A detailed description of the furnace and results of its working will probably be given at a future meeting of the Section.

Mr. D. CRAWFORD, of Langdale's Manure Co., sent for inspection an ordinary red brick which formed part of the lining of a Glover Tower. After three years' constant work the tower had to be emptied in order to renew the saucer, and the bricks

§ *J. Ch. Soc.*, 45; *Ber. deut. Ch. Ges.*, 17.

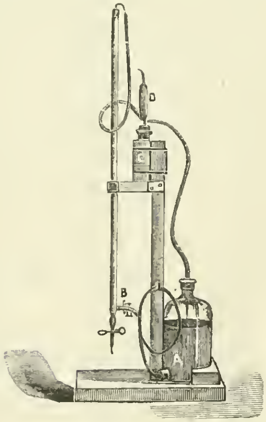
were found to be quite perfect and unacted on, although they were common red bricks, and not fire-bricks. The brick in question was still nearly perfect, though it had been exposed to the air for three months after being taken from the tower.

Mr. J. B. PAYNE exhibited and described Stead's gas-sampling apparatus, Arnold's Bath for colour-test, and Ballard's Chlorimeter; also some samples of "artificial silk," a new filament produced by pressure through a die, from pyroxylin, the invention of Mr. J. W. Swan.

Mr. T. W. STUART exhibited a small ambulance box, containing lint, bandages, restoratives, etc., similar to those distributed throughout Messrs. Tennants' works at Hebburn, in case of accidents.

STARK'S RESERVOIR BURETTE.

IN chemical works laboratories where many titrations of the same kind have to be made, the ordinary reservoir burette, as figured in several text-books, and in which the reservoir for the standard solution is placed at a level higher than that of the burette, is found in practice to be very convenient, as well as to effect a considerable economy in time. Such an arrangement, however, necessitates the reservoir and burette being fixtures, and this in all laboratories cannot without inconvenience be done. The accompanying sketch shows a burette which, while



retaining the advantages of the arrangement above referred to, has the additional advantage of portability. To fill the burette, the reservoir *a* is raised in one hand while the clip *b* is opened by the other. The solution having been adjusted to its proper level, the clip *b* is closed, and the reservoir returned to its place on the stand. It will be noticed that the solution enters the burette by a tubulure at bottom. In introducing this pattern some five years ago, I was not without fear that it was an arrangement which would tend towards increased breakage; such has not been the case, however, as out of a number of burettes of this pattern in daily use under my own observation, during that time not one of them has been broken at this point.

Next, as regards the protection of the standard solution used. It is of course desirable in all cases that standard solutions should be kept as far as possible out of contact with the dust and various fumes to which the air of most works laboratories is at times subject. For this purpose a small wash-bottle *c* is a very simple and very efficient arrangement. In it is placed a little of the solution contained in the reservoir, or such other solution as may be considered more suitable; and, as the whole of the air entering the reservoir has first to pass through this wash-bottle, any deleterious action that might result to the solution takes place therein. Taking the case of arsenite of soda solution used in testing bleaching powder, a little of this solution is put into the wash-bottle, and so efficient is this arrangement that in a laboratory, daily under my own observation and situated within less than thirty yards of one of the largest bleach plants in the country, no variation in the strength of the solution is found to take place during periods of between three and four months. Never less than a three months' supply of this solution is made up at one time in the case I refer to. A safety tube *d* prevents the solution in the wash-bottle being forced out should an expansion of the fluids and air contained in reservoir and burette take place. Where perfect freedom from carbonic acid is required, as in the case of a solution of Baryta water, the wash-bottle can be supplemented by soda-lime tubes as recommended by Dr. Lunge.

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Meeting held December 3rd.

MR. A. M. CHANCE IN THE CHAIR.

A VISIT TO THE OIL FIELDS OF PENNSYLVANIA.

Communicated to the Birmingham and Midland Section December 3, 1884,

BY WILLIAM A. TILDEN, D.SC., F.R.S.,

Professor of Chemistry in the Mason College.

LIKE many other English people I found my way this last summer across the Atlantic to the meeting of the British Association at Montreal, and returning homewards through the United States I found time to visit some of the chief oil regions of Pennsylvania, and some of the refineries. Thanks to the kindness of several friends, I was liberally supplied with introductions, which secured for me a most courteous reception, and the best opportunities of profiting by the visit. Although I have nothing new to commu-

nicate, it occurred to me that an account of this remarkable industry might be interesting to some members of the Society.

The history of the discovery of oil in the United States has been often recited. It is enough, therefore, to say in this place that petroleum was long known to the Indians, who collected it from some of the streams and from the surface of the water of the Seneca lake. The product thus obtained achieved some notoriety as a patent medicine, under the name of Seneca or Genessee Oil. In 1859 the idea arose of boring into the rock in the hope of obtaining a better supply of this medicinal oil, and the first well was sunk near Titusville, a town on Oil Creek, which was the name given by the early settlers to a small stream running into the Allegheny river. This first well produced in 1859 about 2,000 barrels, a quantity far larger than had ever been previously obtained by the rude process of skimming the water on which it was observed. A demand for the oil for burning in lamps soon sprang up, and new wells were sunk in the same district. In 1860 the yield was about 500,000 barrels. In 1861 it was over two millions, and in 1862 it amounted to more than three millions of barrels. At the present time the total product of the United States probably amounts to some forty millions of barrels, whereof more than one-fourth is exported to Europe.

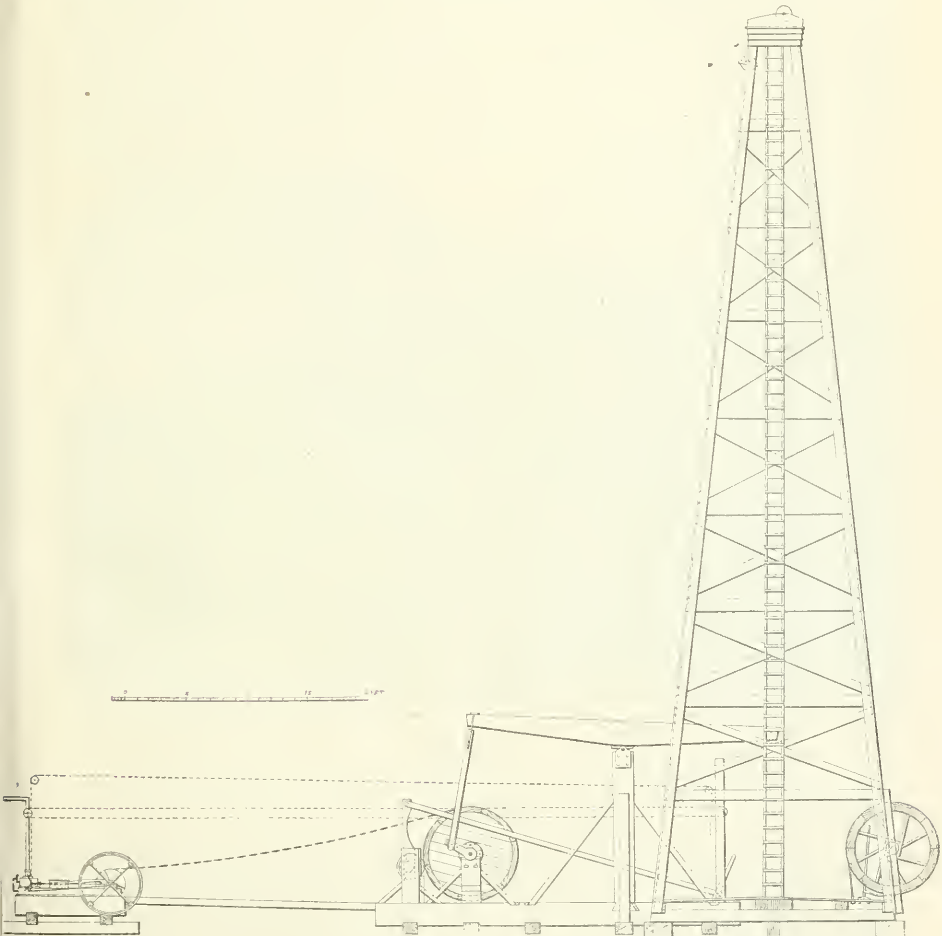

Fig. 1.

The most important oil regions of the United States lie in Pennsylvania, and part of the State of New York, occupying an irregular band of country some 150 miles long, by perhaps 10 to 20 miles wide.

Other oil fields of less importance occur in Ohio, Western Virginia, and Ontario on the Canadian side. In Pennsylvania the oil-bearing rocks belong to the Devonian system, below the carboniferous series, and the oil is not found in contiguity with beds of coal or shale, but in cavities, and dispersed through various porous sandstones. On boring into the sandstone the oil often rises to the surface from a considerable depth, or is even projected upwards into the air by the pressure of the gas which accompanies it. Many of these spouting or flowing wells have been struck, but the flow is generally intermittent, and rapidly declines. The oil is usually attended by more or less salt water.

Those who can look back twenty years can remember the intense excitement which ensued upon the discovery of oil in the United States, and the rapidity with which fortunes were often made and spent. Untaught by experience of what then so frequently happened, speculators continue to rush into the market as wildly as ever; and there is probably no commodity in the world, the price of which is liable to such exaggerated fluctuations as petroleum. As an example of the sort of excitement which follows upon the discovery of a new field, the case of the Cherry Grove district may be recalled. In May, 1882, this region was covered by a dense forest, almost without human inhabitant. A well was bored, apparently at random, and oil obtained in abundance. Thereupon boring was carried on in every direction. In about two months several hundred wells were sunk; near upon 10,000 people gathered together, and two small towns, Farnsworth to the north and Garfield to the south, sprang into existence. But the yield of oil soon began to decline, and by the following spring the majority of the wells were abandoned. As an instance of the effect of the opening of a well in a new district upon the market may be mentioned the well at Butler, which in August last was running some 700 barrels a day. The discovery of this well caused the price of crude petroleum to drop suddenly from about a dollar to 70 cents a barrel, and no one could tell what might happen next.

The Bradford field is the most extensive at present known. Discovered in 1875, and covering some 400 square miles, it continues to be very productive. In 1880 the output amounted to about five-sixths of the yield of all Pennsylvania. The town possesses many substantial buildings, a busy petroleum exchange, and contains upwards of 10,000 inhabitants.

The course of my own journey took me from Pittsburg by the line which follows the Allegheny river to Oil City. A great deal of business is done on the exchange at this place, and the head office of the United Pipe Lines is there; but very little, if any, oil is now got from the wells, and the "derricks" stand in black decay upon the hill sides. From Oil City through Tidioute, Warren and Kinzua, and thence by the narrow gauge line over the hills to Bradford, I passed through some of the most interesting districts, amid pretty country covered for the most part with forest.

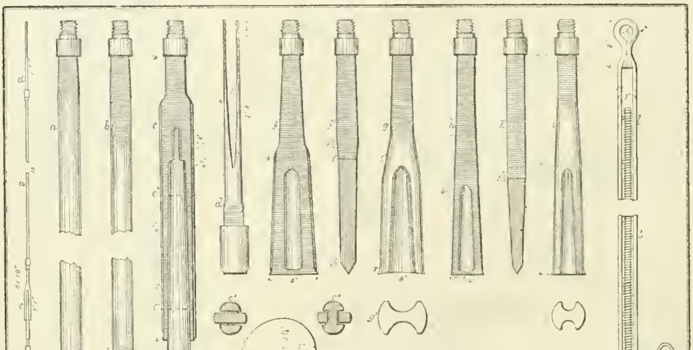

Fig. 2.

The process of boring a well is accomplished in the following manner:—An open timber frame about 70 feet high, called a "derrick," (see fig. 1, p. 35) is rigged up on the spot for the purpose of raising the boring tools. The latter (see fig. 2) consist of several iron rods screwed together, and terminated by the "bit," with its sharp auger-shaped extremity, the whole being lifted up when required, and let down by a rope which passes over a wheel at the top of the derrick, and round the large windlass or "bull-wheel" at the bottom. The tools are set to work by a small engine, which is afterwards

used if necessary for pumping. The pulverised rock is removed every few feet by means of a "sand-pump," and when a depth of some three hundred feet has been reached a wide iron tube or casing is introduced in order to keep water out of the well. When the drill has penetrated as far as the oil-bearing sand, the well tubing, about two inches in diameter, is put in, and the space between it and the bottom of the casing is fitted in by a bag of linseed, which is forced down into position, and soon swells so as to form a water-tight joint. The wells vary in depth from 600 or 700 feet to 1600 feet, and each one costs from 3000 to 4000 dollars. As already mentioned, on striking the oil sand, the oil is often projected from the boring with considerable force into the air, but if not, it requires to be raised by a pump. This is of the simplest description, consisting of a long jointed rod, with a short cylinder at the extremity, provided with a valve opening upwards. As the oil is raised, it is pumped into a wooden tank standing near the well. When the well-owner desires to dispose of the product of his well, he sends for the agent of one of the companies that undertakes the transfer of the oil from the wells to the great storage tanks, or to the refining centres. The latter are situated at Cleveland, Buffalo, Oil City, and near New York, the tendency being to concentrate the refineries upon the seaboard. The oil then at the well, after being gauged by a stick, is drawn off, and a certificate handed to the proprietor crediting him with the amount run off, less a small allowance for water and loss. The conveyance of the crude oil is now a very simple matter, being accomplished almost exclusively by the pipe lines. In the earliest days of petroleum the oil was carried in barrels, but as this was both an inadequate and expensive plan, large covered wooden tanks, borne on railway trucks, were employed. But these in their turn gave place to iron tanks shaped like a cylindrical boiler some 25 feet long and 5 or 6 in feet diameter, and surmounted by a cupola. (See figs. 3 and 5). The iron tank cars still convey a considerable quantity of oil to market, not direct from the wells, but from certain centres to which it is brought by the pipes. The whole of the work, both of storage and transport, in Pennsylvania, is undertaken by two companies, of which the United Pipe Lines is by far the larger. The oil from the private tanks at the wells is run through pipes by gravitation into the great storage tanks situated in the nearest valley. Scores of these are to be seen in the neighbourhood of Bradford and Olean, and they give a feature to the landscape even more remarkable than the derricks themselves. Fig. 4 gives a view of the pumping station and tanks in the valley at Colegrove, McKean County

Fig. 3.

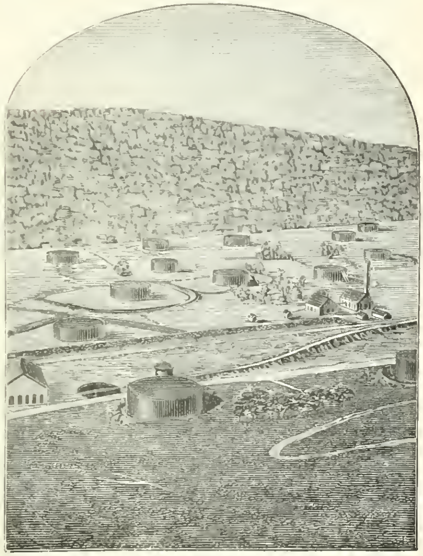

Fig. 4

The tanks are huge drums of sheet iron, the older ones containing about 25,000 barrels. They are now generally made of larger capacity, being about 95 feet in diameter, 35 feet high, and hold 35,000 barrels. (A barrel = 42 galls.) From the producing districts the oil is driven by powerful force pumps through the mains (4-inch iron pipe). At a distance of 20 or 25 miles it is received in a tank similar to that from which it was drawn, and is again propelled forward by pump to the next station, and so on to the end of the line. The longest lines are from Olean, on the north of the Bradford field to New York, about 300 miles, and altogether the United Pipe Lines own about 3000 miles of pipes, which spread as a network over almost the whole of the oil fields of Pennsylvania. The magnitude of the business they carry on can be inferred from the official statement of the assets and liabilities of the National Transit Company on 30th June last, from which it appears that the oil then in custody of the Company amounted to about 38½ million barrels, or more than 1,600,000,000 gallons.

The natural petroleum from the wells varies a good deal in density and composition, but with one or two exceptions, it is bulked in the storage tanks, and the price is independent of quality. The material operated upon by the refiner is therefore tolerably uniform. Distillation is conducted in iron stills of 1,200 or even 1,500 barrels capacity fired by coal. The Standard Oil Company are by far the largest refiners, having establishments at Cleveland, Pittsburg, New York, Philadelphia, and in fact at all the chief refining centres.

At their works in New Jersey, not far from New York, the following figures were given me as representing approximately the results of the distillation. The oil in the tanks at common temperatures, and especially in summer time, evolves a good deal of gas, and more is given off on first applying heat. The first condensable distillate or "naphtha," including gasoline, benzoline, and heavier "benzenes," varies from 6 to 15 per cent. The burning oil, divided into two qualities, amounts to 75 to 80 per cent., and the

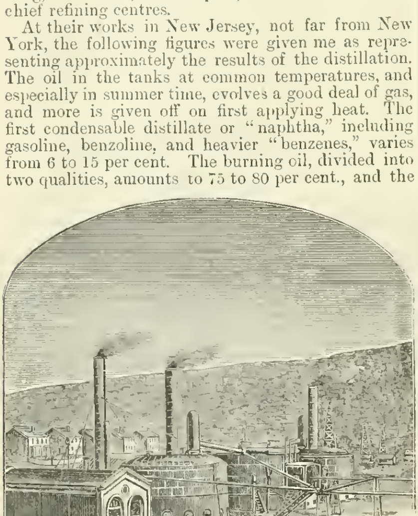

Fig. 5.

residue of 8 to 10 per cent. by separate distillation yields lubricating oil. The oil is heated in stills which hold about 250 barrels each. It begins to boil at about 650° F., and a residue of nearly 20 per cent. of coke is obtained. The latter is burnt under the stills.

For the production of paraffin wax, certain portions of this distillate are cooled by the aid of ammonia freezing machines down to a temperature of 22° F. It then becomes pasty from the separation of scaly crystals of paraffin. These are pressed by hydraulic presses in a room the temperature of which is about 40°, or very little above freezing point. The cake thus obtained is remelted and pressed again at a temperature as near to 80° F. as possible, the room being heated in winter by steam. The wax is not perfectly white, and its melting point is about 126° F. Only one quality is made, and it is wholly exported to Europe, as candles are but little used in America, and other applications for it are limited. The burning oil is further refined by agitation with a little sulphuric acid, the agitation being effected by means of air blown in at the bottom of a deep tank. The acid is separated, the oil washed with water and a little soda, and settled. It may afterwards be bleached, if so required, by exposure to sunlight in a glass-roofed tank.

At the New York refinery of the Standard Oil Company, the cooperage, turning out 8,000 finished barrels a day, is one of the most interesting departments of the works.

It was not my fortune to see a fire, though as may be imagined these catastrophes are of common occurrence, not only in the refineries, but in the field. The crude oil in the storage tanks continually gives off hydrocarbon gas, and when a tank is struck by lightning, the gas is frequently inflamed, and so the oil ignited. In order to prevent communication from one to another, each tank is isolated as much as possible by a dry ditch and bank which surrounds it. When a tank catches fire, a cannon is sent for, and shots are fired at the lower part of the tank so as to make holes and allow the oil to escape. If this is not done, there is risk of the oil boiling over, and setting fire to other tanks near.*

* Thorn Creek, December 21.—The burning well belongs to the list of sensations which the Thorn Creek district has furnished the Oil Region. Many visitors have been attracted here by it, and all day an admiring crowd lingers in the vicinity. The well is flowing about 2,500 barrels a day, or 100 barrels an hour, and this enormous amount of oil is shot from the top of the casing head in a steady stream, and with a velocity which is like the rush of a cannon ball. For several feet above the top of the casing head there is no flame, owing to the speed with which the gas and oil come from the well, and for over fifty feet up the course of the stream of oil and gas can be marked through the flame before it is lost in the fire. Were it not blazing the oil would shoot in a solid stream over 100 feet high; but now it is a writhing column of white fire for the first 100 feet, and above this red billows of flame roll up 75 feet higher before its fiery colour is lost in the black rolls of smoke. At night the fire lights up the surrounding country for miles, and on Monday night one could see to read print by the light of the fire a mile and a half away, while the pipe line gaugers all over the district can see to do their work by it. Its heat is not so great near the ground as might be imagined, but can be felt best part way up the hill. One gets the best view of the fire from the plank road near the McBride well. From this point, early in the morning, just as daylight begins to creep over the hill, the sight is magnificent. The base of the well is a little higher than the point of observation, and the whole column of flame reaching 175 feet in the air, is brought into strong relief against the dark background of the hill beyond. Nearly every one who has heard of the fire or seen it, has some theory of extinguishing it. But few of them consider the force they have to contend against. The oil and gas coming from the casing head would play with tons in weight as if feathers. Compared with this giant the burning well on 617, Cherry Grove, was a pigmy. A few days since one of the workmen approached the flame near enough to touch the stream with the end of an iron sucker-rod; but scarcely had it touched it before the rod was sent whirling up and outward as if it had been the merest wooden splinter. Messrs. Ross and Bredin have been endeavouring to extinguish the flames. Mr. Ross brings to the work his experience in extinguishing the burning well at 617. His apparatus consists of a piece of casing standing upright, and connected at the base with two lines of casing leading away from the well. The idea was to drop the end of the upright piece of casing over the casing head, and allow the stream of oil and gas to shoot up out of the end of it. This was provided with a valve, which, when proper connections had been made with the other casing lines to tanks, was to be closed, shutting off the stream feeding the flames, and turning the oil through the lead off lines. The men while carrying this apparatus to the fire were to be protected by sheet iron screens and umbrellas held before them. Several attempts were made last night and to-day to get the apparatus over the fire, but the force of the stream and the heat have so far baffled all efforts. When this well caught fire on last Friday, December 19th, it was producing 600 barrels a day. Since burning its production has increased until on Sunday and Monday it was estimated to be flowing at the rate of 3,000 to 4,000 barrels a day, and to-day is probably making 100 barrels an hour. It is the theory of many in the field, and it may be the correct one, that the burning of the well has created a suction on the sand which is drawing the oil from the other producing wells. The same wells which were producing 325 barrels an hour on the morning of the day that Fisher No. 8 caught fire, were producing 175 barrels an

It does not appear to be the custom to employ trained chemists in the oil refineries, and perhaps the necessity for high scientific skill is not very apparent in an industry such as this which has shaped itself to a settled routine. But I was not quite prepared for the ignorance which seems to prevail generally as to the nature of the material. I was told more than once that aniline colours were made from the oil, and I observe in a popular article in the "Century" for July, 1883, a statement to the same effect. I could get no further information on the subject.

In England and in Europe generally the quality of burning oil is determined by some variety of "flashing" test, that is by observation of the temperature at which the oil emits inflammable vapour. The Americans use a "fire" test with the same object. Their test consists in noting the temperature at which the oil itself catches fire.

that region in common with others in which mineral oils are obtained. This gas consists of marsh gas, accompanied with small quantities of its homologues in vapour. Sometimes hydrogen is also present in appreciable quantity. The following table, which gives the composition of several specimens, is extracted from the Report of the Committee on Natural Gas of the Engineers' Society of Western Pennsylvania.

Formerly the gas was regarded rather as a nuisance, and when a man drilling for oil got only gas, he considered himself very unlucky. But opinion on this matter is changing, and in Pittsburg and the neighbourhood the gas is being applied extensively for all kinds of manufacturing operations as well as for domestic purposes. I visited the Edgar Thompson Steel Works at Bessemer, and the Plate Glass Company's Works at Creighton, near Pittsburg, in both of which natural gas was the only fuel employed. The blast furnace alone is supplied with coke, but

COMPOSITION OF NATURAL GAS FROM VARIOUS SOURCES.

Constituents.	1 Petrolia, Canada.	2 West Bloomfield, N.Y.	3 Olean, N.Y.	4 Fredonia, N.Y.	5 Pioneer Run, Venango Co., Pa.	6 Burns Well, near St. Joe, Butler Co., Pa.	7 Harvey Well, Butler Co., Pa.	8 Cherry Tree, Indiana Co., Pa.	9 Leechburg.	10 Creighton.	11 Penn Fuel Co.'s Well, Murraysville.	12 Fuel Gas Co.'s Well, Murraysville.	13 Rogers' Gulch Wirt Co., W. Virginia.	14 Gas from Marsh Ground.	15 Baku on the Caspian Sea.	16 Occluded in Wigan Cannel.	17 Blower in Coal Pit, S. Wales.
Hydrogen	Chiefly marsh gas, with some ethane and carbonic acid.	..	..	..	..	6·10	13·50	22·50	4·79	..	..	19·56	Marsh gas with small quantities of nitrogen, and 15·86 per cent. carbonic acid.	..	0·98	..	..
Marsh Gas		82·11	96·50	Marsh gas, ethane and butane.	Chiefly propane, with small quantities of carbonic acid and nitrogen.	75·44	80·11	60·27	89·65	96·31	Marsh gas with a little carbonic acid.	78·21		47·37	93·09	80·69	95·42
Ethane		..	..			18·12	5·72	6·80	4·39	..		..		..	..	4·75	..
Propane		..	..			trace	..	..	trace	..		..		..	..	..	..
Carbonic Acid		10·11	..			0·31	0·66	2·28	0·35	3·64		..		3·10	2·18	6·44	0·60
Carbonic Oxide		..	0·50			trace	trace	trace	0·26	..		..		..	..	..	..
Nitrogen		1·31	..			..	..	7·32	..	..		..		49·39	0·49	8·12	3·98
Oxygen		0·23	2·00			..	..	0·83	..	..		2·20		0·17	..	..	..
"Illuminating Hydrocarbons."		2·94	1·00	..		..	..	..	0·56	trace	..	..		..	3·26	..	..

1. Fouqué, Comptes R. lxvii. 1045.
2. H. Wurtz, Amer. J. Arts Sci. [2] xlix. 336.
3. Robert Young.
4. Fouqué, Comptes R. lxvii. 1045.
5. " " "
6. S. P. Sadtler, Report L. 2nd Geol. Sur. Pa. 153.
7. " " 3rd " " 152.
8. " " " " 153.
9. " " " " 153.
10. F. C. Phillips.
11. Robert Young.
12. Rogers.
13. Fouque, Comptes R. lxvii. 1045.
14. Bischof's Chem. Geol. 1. 730.
15. " " "
16. J. W. Thomas, J. Chem. Soc. 1876, 793.
17. " " " "

No account of the old regions of Pennsylvania would be complete without a reference at least in passing, to the great supplies of natural gas found in

hour this morning, a decline of 150 barrels an hour, or of over one half since the day previous to the fire. Conners No. 1 has stopped entirely, while the stoppage of Phillips No. 5 undoubtedly causes Fisher No. 1 to hold up better than the others. Whether the theory that the burning well is drawing from the others be correct or not, it is accepted by most of the fieldmen and the operators in the vicinity, for those having wells near Fisher No. 8 have added $750 to the sum offered to any one who will extinguish the flames.—Extract from the *Oil City Derrick* newspaper, December 25, 1881.

there appears to be no other process in operation among the industries carried on round Pittsburg to which the gas is not applicable. According to the Report just referred to, no fewer than 150 companies had been chartered up to February last for the supply of natural gas in Pennsylvania, and many more were in process of formation.

The permanence of such a supply is of course a question of supreme importance, but as many of the wells have continued to yield large quantities of gas pretty regularly for many years, there is but little

risk of the supply failing. The pressure at the wells is enormous, being commonly 75 to 100 pounds, and even reaching more than 150 pounds on the square inch. This high pressure, whilst in general a source of trouble, may turn out to be a condition of real advantage. It is necessary in order to burn the gas conveniently and to avoid dangerous leakage from the mains, to reduce the pressure so as to be equal to a few inches of water, and this is found to be most satisfactorily effected by means of a tank governor similar in principle to the ordinary gasometer. But it is now proposed to make use of the pressure of the gas itself by driving it through an ordinary steam engine before it is delivered into the gasometer to be employed as fuel for the purpose of raising steam. If this should be satisfactorily accomplished, the "power" then at the disposal of the manufacturers of Pennsylvania will be cheaper and more abundant than in any country in the world.

DISCUSSION.

Mr. Enoch Evans: I should like to know whether Dr. Tilden had an opportunity of observing anything in the conditions under which petroleum is found which would enable him to offer an opinion as to the origin of the oil existing in the sandstone, and why it is so much more free from sulphur compounds than the products which are obtained by artificial distillation. I should also like to ask Dr. Tilden if he can give the calorific power of the gas which was used for obtaining the high temperature necessary in melting steel.

Mr. Charles Hunt: May I ask a question with regard to the pipes used for conveying the oil by the Pipe Lines Company whether they are laid underground or if there is a public road upon which they could be laid. With regard to the natural gas which has been described, I infer that it is of very low illuminating power, being composed of marsh gas, but very pure—that is free from sulphur.

Mr. Horace Brown: There is one product from the petroleum which I should like to ask about, and that is vaseline, and from what it is obtained.

Dr. Tilden: The pipes by which the oil is conveyed are carried partly over the open country, but the mains run chiefly alongside the railway track. I believe a good many of the local railway lines belong to the United Pipe Lines Company or to the Standard Oil Company, the effect being that all the oil produced in a district necessarily passes through the hands of the representatives of one of these companies, and they work the thing between them.

One speaker has enquired why petroleum is free from sulphur. The answer to that is that petroleum is not always entirely free from sulphur, and as to the origin of the oil, though I have no special views upon the subject, I may mention that the idea of petroleum being a product of distillation is not the only available hypothesis. Mendeléjeff has suggested that these natural stores of hydrocarbons may have resulted from the action of steam or water upon masses of carbides of iron. As to the illuminating power of the natural gas, it is of course generally very low, but it may be improved to any extent by mixing with it a small quantity of the vapour of the lightest naphthas got in the distillation of the oil. The heating power is not to be wondered at when we consider that producer gas which contains no more than about one-third of its volume of combustible ingredients, the rest being carbonic acid and nitrogen, is capable of yielding any desired temperature. The natural gas consists wholly of combustible hydrocarbons, and is therefore capable of doing all that producer gas can do and more. The one practical difficulty is the regulation of the pressure.

Glasgow and West of Scotland Section.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the Meeting to be sent to the Local Secretary.

The following is the business for the next meeting of the Section (Tuesday, Feb. 3rd):—1. "Bromine Absorptions," by Professor Mills; 2. Professor Mills will open a discussion on "The Proposed Rivers' Pollution Bill."

A meeting of this Section was held in the Rooms, 207, Bath Street, on Tuesday, 6th January, at 8 p.m.

MR. E. C. C. STANFORD, IN THE CHAIR.

The minutes of last meeting having been read and confirmed, the following papers were read:—

ON A NEW FORM OF GAS THERMOMETER.

BY GEORGE BEILBY.

The gas or air thermometers hitherto described, may be referred to three classes, typified by certain well-known instruments; these are:—First, the air thermometer of Regnault; second, the differential thermometer of Leslie and Rumford; and third, the air thermometer of Berthelot. Regnault's thermometer has a well-ascertained value for the accurate determination of all temperatures above 0°, and below the softening point of glass. Each determination involves a somewhat lengthy cycle of operations, the instrument is therefore inapplicable to the determining of rapidly changing temperatures. Leslie and Rumford's differential thermometer, in which two air thermometers connected by a U-tube containing sulphuric acid or other liquid, work against each other, is chiefly of use for the observation of minute *differences* of temperature. In Berthelot's air thermometer changes of temperature are measured by changes of pressure indicated by a mercury gauge.

The physical effect of temperature on gases being expressed either in terms of volume or of pressure, instruments of the first class may be called *volume* thermometers, and those of the third class *pressure* thermometers. In the former, changes in the volume of the enclosed gas at constant pressure are measured, in the latter, changes of pressure with constant volume. Instruments of the differential class occupy an intermediate position as both volume and pressure are changed under variations of temperature.

About a year and a half ago, having felt the want of a trustworthy instrument for the rapid measurement of temperatures above the range of the mercurial thermometers, I began a course of experiments with the object of constructing such an instrument if possible. These experiments, carried on in the intervals of other work, have lasted till now and are not yet concluded.

The simplicity of Regnault's air thermometer made it a most excellent starting point for my purpose. To this instrument it was necessary to add some appliance by which the gas expelled from the vessel exposed to an unknown temperature could be rapidly and, if need be, continuously measured at constant temperature and pressure.

Fig 1 shows such an arrangement, being an adaptation of a form of apparatus frequently used in gas analysis. From the bulb or expansion vessel *e*, a tube *c* of relatively small cubic capacity is led to the graduated cylinder or measuring tube *m*, which is connected at its lower end with another perpendicular tube *t* by the fork piece *f*, these tubes are connected by a flexible tube *i*, with the reservoir *r*, which can be raised or lowered between the upright guides *g*. An outer cylinder *j* surrounds the tubes *m* and *t*, and forms a receptacle for water, steam or other medium used for the maintenance of a constant temperature. The thermometer *d* is used in regulating the temperature. The liquid in the reservoir *r*, and tubes *m* and *t* may be water, oil of vitriol, mercury or a liquid hydrocarbon. The pressure within the tube *m* can be adjusted to the atmospheric pressure of the moment by bringing the reservoir *r* to the position in which the liquid in the tubes *m* and *t* stand, at the same level. In connecting up the apparatus for use, the stopcock *s* is opened and the level of the liquid in the tubes *m* and *t* is brought to the zero point, while the bulb *e* is immersed in melting ice. The temperature of the tubes *m* and *t* must be carefully kept at the standard temperature for which the instrument is graduated, which may conveniently be 0°, 15°, or 100° When the zero point is adjusted the stopcock *s* is closed and the instrument is ready for use. It is evident that the adjustment may, with equal convenience, be made at the temperature of boiling water.

The graduation of this instrument is of course quite different from that of an ordinary mercurial thermometer, in which practically the whole mass of mercury is subjected to heat, and expanded at each temperature. The expansion of the mercury being uniform for equal increments of heat, and the mass constant throughout the range, the degrees at all parts of the scale are equal in size. In the instrument under consideration the mass of gas in the expansion bulb *e* is not constant under changes of temperature, but decreases with every increment. The amount therefore expelled per degree decreases as the temperature rises and the degrees on the scale of the tube *m* become smaller and smaller. Let the capacity of the expansion bulb *e* be 100 vols. at 0°, and let the mass of the gas contained at that temperature be 100, then

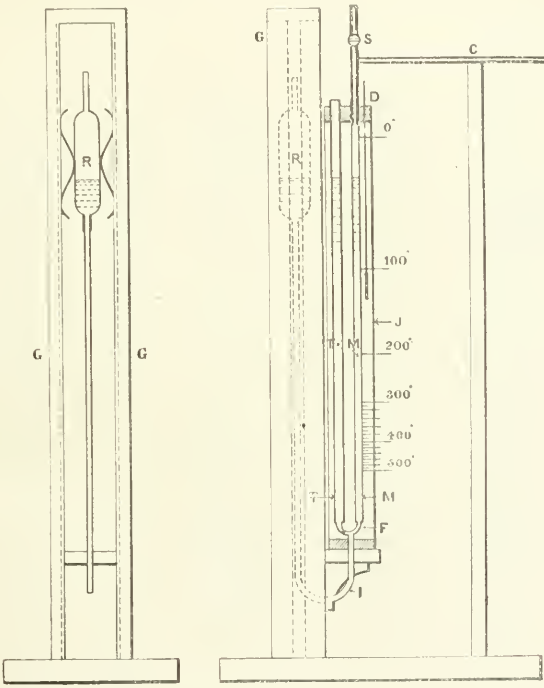


FIG. 1.

the proportions of air retained in the bulb and expelled from it will be as follows :—

TABLE I.

Temp.	Mass in bulb.	Mass expelled.
0°	100·00	0·
100	73·19	26·81
200	57·72	42·28
300°	47·65	52·35
400	40·57	59·43
500°	35·36	64·64

The *volumes* of the quantities of expelled gas as given in the third column will, of course, depend on the temperature of measurement. In the apparatus under consideration the insulation of the expansion bulb *e* from the measuring tube *m* by the connecting tube *c*, makes it possible to keep the former at any convenient temperature, quite irrespectively of the temperature of the bulb. A glance over the table shows that at all temperatures above 300° (strictly speaking, above 273°) the mass of air in the measuring tube is greater than that in the expansion bulb ; it is evident therefore that absolute control must be maintained over the temperature of the measuring vessel. This is forcibly illustrated by the fact that when the expansion bulb is at 500°, one degree of variation in the temperature of the measuring vessel involves an error of about five degrees on the indicated temperature.

The choice of the temperature for the measurement of the expelled gas is determined by two primary considerations—first, that the temperature chosen must be maintainable with ease and certainty under the conditions in which the instrument will ordinarily be used ; second, that for accuracy in measuring small increments of volume a high temperature is desirable.

Weighing, in the light of the above considerations, the two standard temperatures, the melting point of ice and the boiling point of water at normal pressure, the latter has clearly the strongest claim, as it really fulfils both requirements ; it is more easily maintained under all the conditions likely to occur than the melting point of ice, and it insures for the thermometer a much more open scale at high temperatures.

When steam is used in the jacket *j*, water cannot be used in the tubes *m* and *t*. Mercury is used

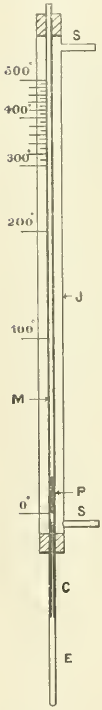


FIG. 2

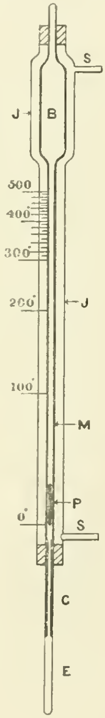


FIG. 3

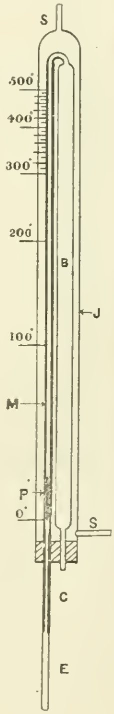


FIG. 4.

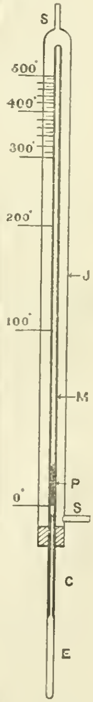


FIG. 5.

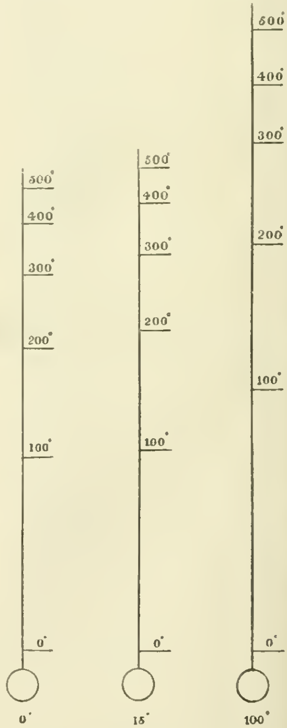


FIG. 6.

instead, and drying tubes are fitted on *m* and *t*, so that only dry air can enter these tubes, as the least moisture condensing on the surface of the glass would cause the mercury to film the glass. The jacket *j* is provided with a loaded valve, by which the pressure of the saturated steam within may be regulated and maintained at 760mm., quite irrespectively of the atmospheric pressure at the time. In this way a uniform temperature of 100° can be maintained round the measuring tube.

When water is used in the jacket *j*, and takes *m* and *t*, 15° is a convenient temperature to use. In this case means must be provided for the circulation of water from a reservoir through the apparatus, to maintain this temperature against external differences. Table 2 and diagram fig. 6 show numerically and graphically the effect on the thermometer scale of the measurement of the expelled gas at three temperatures—0°, 15° and 100°.

TABLE II.

Temp. of Bulb.	Expelled Gas measured at 0°	15°	100°
0°	—	—	—
100	26·81	28·28	36·63
200	42·28	44·60	57·19
300	52·35	55·23	71·53
400°	59·43	62·70	81·20
500°	64·64	68·23	88·33

For temperatures above 500° some material other than glass would probably have to be employed for the expansion bulb. The porosity of platinum and other metals at high temperatures has made them quite inapplicable for the construction of *pressure* thermometers, but I have as yet made no experiments on their suitability for the expansion bulbs of *volume* thermometers.

During the past year I have made many attempts* to construct a compact thermometer on the principle of that now described—that is, *the measurement at known and constant temperature and pressure of the gas expelled from a bulb or vessel of unknown temperature.* Figs. 2, 3, 4 and 5 show the most important of these modifications. In all of the figures, 1, 2, 3, 4 and 5, the same letters are used for corresponding parts; *e* is the expansion bulb, *c* the connecting tube, *m* the measuring tube, *j* the jacket surrounding the measuring tube. Instead of the tubes *m* and *t* containing mercury or other liquid, a piston or plug of mercury *p* is introduced in the tube *m*, to confine the gas and as an index for its measurement. In the instrument shown in fig. 2, the end of the tube *m* is left open to the outer air, and changes of atmospheric pressure affect the pressure and volume of the gas enclosed by the mercury plug. Exposure to the outer air has the further disadvantage that moisture from it condensing on the surface of the glass causes the mercury to film and drag in the tube. Figs. 3 and 4 show two varieties of the next form. To the open end of the tube *m* is attached a bulb or vessel of about 100 times the capacity of the bulb *e*. This instrument having been carefully filled with dry gas of any required tension by means of a mercury pump, the piston of mercury is passed into its place and the tube at the end of the bulb *b* is sealed off. When in use, the bulb *b* being of relatively large dimensions, maintains a nearly constant pressure within the apparatus, the actual variations being calculated and allowed for.

The instrument exhibited, which is similar to that shown on fig. 5, was made eight or nine months ago, and has been used for taking boiling points of paraffin oils up to 450°. It was found that in practical use the mercury index changed its zero point slightly after each journey up and down in the measuring tube. This error under certain conditions was cumulative, and—owing to the construction of the thermometer—could not easily be rectified without opening and refilling the tubes. This matter was made the subject of direct experiment with a view to the discovery and removal of the cause. At that time the anomalous behaviour of the mercury index could not be explained satisfactorily, but discoveries made since have thrown fresh light on the matter. Under the belief that the alteration of the zero point of the index resulted simply from the passage of gas past the mercury plug, a new form of instrument, shown in fig. 6, was constructed. The mercury column *p* is lengthened to about 2 inches, the tube *m* is made of extra length and is sealed at the top, the bulb *e* and tube *m* are filled with dry gas at a tension slightly under that due to the column of mercury *p*, so that, when the instrument is turned perpendicularly with the bulb downwards, the column of mercury passes down in the tube till it is balanced by the pressure of the gas below it; a vacuum being left in the upper part of the tube. Changes of volume in the gas in the bulb and lower part of the tube *m* make the column rise or fall in the tube, but, as the pressure on this gas is solely due to the weight of the column, the mere height of the latter does not affect the pressure. After each operation the instrument is inverted so that the column of mercury runs down to the end of the tube, and if any gas has passed the column it appears as a bubble between the mercury and the end of the tube. The tube is sufficiently wide to permit of the bubble being passed up through the column by smartly tapping the lower part of the tube. The ease with which the error may be corrected after every operation adds considerably to the confidence with which the instrument is used.

In making thermometers of this form certain curious facts were brought to light which go far to explain the anomalous behaviour of the mercury column already referred to. I have found that a large volume of gas is condensed or occluded by the mercury or by the glass, or by their combined action.

R. Bunsen (*Chem. Soc. Journ.*, xlvi. 146) has shown that air and carbonic anhydride are condensed by glass surfaces, and practical thermometer makers are familiar with the fact that certain kinds of glass cannot be used for making accurate standards because of the amount of gas they occlude, but it is very doubtful if the occlusion or condensation referred to above can be accounted for by the glass alone. I hope soon to publish the results of experiments made specially to determine how and where the occluded gas is retained.

Until the laws of the behaviour of gases in tubes containing mercury are fully understood, some uncertainty will prevail as to the accuracy of the indications of temperature given by the forms of thermometer shown on figs. 2, 3, 4 and 5; but in the meantime they at least form valuable adjuncts to the more trustworthy but cumbrous instrument shown on fig. 1.

* The author's first published account of this system of thermometry was in the Provisional Specification of Patent No. 3750, dated 22nd February, 1884.

AIR OR HYDROGEN THERMOMETER FOR LOW TEMPERATURES.

BY J. J. COLEMAN.

MR. COLEMAN described and exhibited an air or hydrogen constant-pressure thermometer he had specially devised for taking low temperatures, say, to 300° below zero F. In this thermometer the bulb was about 10 inches long and ⅝-inch diameter, from which proceeded upwards a tube bent at right angles, and then turning downwards into a wider tube graduated and open at the bottom end. The open leg of the instrument was dipped into oil contained in a cylindrical outer tube mov-

able on a pulley, so that the level of the oil inside and outside the recording leg was maintained constant every time an observation was to be taken, thus eliminating errors from the weight of the column of liquid. The recording leg of the instrument is kept at a constant temperature; in fact, the whole upper part of the instrument, by building round it suitable protecting walls within which the temperature was maintained constant by small gas jets. Each observation of course required correction with a barometric observation. The instrument was graduated in absolute temperatures F. Thus 62° F. was really 522° absolute, and the length of a degree at this point was ascertained by comparison with a Kew certified thermometer 30° above and 30° below. The length of a degree at a fixed point being obtained, it only remained to consider that at half the absolute temperature the degree would be doubled in length, and the intermediate degrees were calculated accordingly.

TENSION-THERMOMETERS AND PYROMETERS.

BY PROF. W. DITTMAR.

Professor Dittmar exhibited a number of manometers made by Messrs. Schäffer and Budenberg, and also one of their "Thalpotassimeters," and explained the construction and working of the last-named instrument. The following is a condensed report of Mr. Dittmar's remarks:—The "Thalpotassimeter" is nothing but a Bourdon manometer adapted to the purpose of thermometry. In the Bourdon manometer the working part is a flat tube of elastic metal bent into the form of a semi- (or more than semi-) circle, the inside of which communicates with the steam (or gas) whose tension is to be measured. If this tension is greater than that of the atmosphere, the tube opens out, because the inside overpressure tells more strongly on the concave than on the (shorter) convex flat inside of the tube; and, as the inlet end is fixed, the other end suffers a displacement, which is the greater the greater the over-pressure inside. If the pressure inside the tube fall below that of the atmosphere, the tube bends in—*i.e.*, its radius of curvature becomes less; and in either case the displacement of the free end measures the positive or negative over-pressure of the gas or vapour inside—in this sense, at least, that any given value of the latter corresponds to a certain definite displacement. This displacement, however, in all cases, is too small to be measured directly; it, therefore, is being magnified by means of a lever and a system of toothed wheels, so that an even small displacement of the pipe-end becomes translated ultimately into a large angular motion of a hand on a dial. In the vacuum and other low-pressure gauges, the pipe is made of brass, as in Bourdon's original instrument; for larger pressures, Messrs. Schäffer and Budenberg use a steel tube, which (as shown by the model exhibited) is fitted to the pipe conveying the vapour (or other gas) without the use of solder or packing of any kind. And yet, being made with, one may well say, *Whitworthian* precision, the joint keeps tight even under an over-pressure of 25 tons on the square inch. It is also worth stating that these pipes (even the brass ones), as long as they are not over-wrought by being used for higher pressures than they are intended for, prove *perfectly* elastic, and consequently consistent with themselves in their indications. Supposing the steam of a boiler to be turned on against a Bourdon gauge, the first effect of course is that its pipe fills with condensed water, and this is an advantage, because it serves to keep the pipe cool, and the water transmits the pressure as faithfully as steam or air would. Now, the pressure of the steam of a boiler (as the pressure of the saturated vapour of any *pure* substance) is a function only of its temperature, every one temperature t corresponding to *one* certain pressure p; hence our gauge, although intended to be only that, is really a thermometer; because a glance at Regnault's table would enable one to translate the pressures it indicates into degrees centigrade. It is a thermometer, it is true, only in reference to the boiler which it is attached to. But there is nothing to hinder us from providing the gauge with a special little boiler of its own, and we thus convert it into a "thalpotassimeter," or tension-thermometer, as I prefer to call it, because Mr. Budenberg's designation of his instrument is "Greek"—to me, at any rate. That the tension-thermometer scale is figured and divided so as to give temperature value *directly*, needs not be specially stated. The instrument, of course, is not confined to water for its working liquid. Messrs. Schäffer and Budenberg, in fact, make three kinds—namely: 1st, one in which *ether* is used (for temperatures from about 100° F. to a little beyond 212° F.); 2nd, one with water inside for the range of temperatures prevailing in steam boilers up to the highest-pressure ones, and even higher up; and last, not least, one with *mercury* inside for *very* high temperatures. When I first heard of these tension-thermometers my impression was that, however it might stand with the ether and water instrument, the mercury one would be sure to live as the pyrometer of the future. It is almost impossible to find a vessel which is gas-tight and retains its volume and form at even a dull red heat; hence the difficulty of constructing a really reliable air or gas pyrometer. The mercury-tension thermometer is relatively independent of these conditions: as long as the mercury vapour does not actually fizz out, and although the vessel may suffer a permanent deformation, the vapour-tension will remain all right, and the temperatures be recorded correctly in the sense of consistency at least—*i.e.*, although, from a certain temperature upwards, the relation between temperature and pressure is unknown, even these higher temperatures are all, so to say, precisely "labelled" by their respective dial-hand readings. So I thought; and great, therefore, was my disappointment when I was informed that it is just the mercury-thalpotassimeters which have failed to give satisfaction. When used constantly for high temperatures (*i.e.*, when employed for what they are made for) the mercury sooner or later *will* come out somewhere, and the instrument become useless. In contrasting the tension-thermometer with the ordinary mercury-thermometer, the speaker pointed out that in regard to potential sensibility, the former is at least on a par with the latter, because it is always easy to find a liquid, the vapour-tension curve of which ascends with sufficient boldness within the given range of temperatures. The tension-thermometer, besides, is not liable to any displacement of the zero. [Its indication, it is true, varies with the pressure of the atmosphere; thus, for instance, the reading *meant* to correspond to $30+p$ inches does so only when the barometer stands as 30 inches exactly, it really corresponds to $29+p$ inches when the barometer falls to 29 inches. In Budenberg's instrument this does not matter much because he discounts only high tensions at which a plus or minus of even half-an-inch of mercury-pressure corresponds to only an insignificant difference of temperature.] And the *Budenberg* tension-thermometer is not intended for "*haute precision.*" Unfortunately for its popularity, it is very expensive: the instrument here exhibited costs, I believe, £4.

DESCRIPTION OF AN IMPROVED THERMOMETER FOR TAKING HIGH TEMPERATURES.

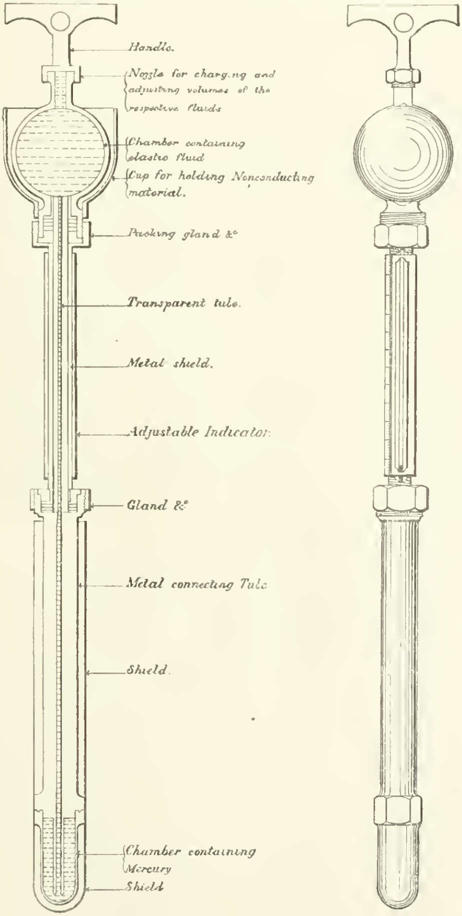
BY JAMES MURRIE.

The upward range of a mercurial thermometer is limited by the boiling of the mercury at a certain point, which varies under certain conditions. By increasing the pressure or resistance tending to prevent ebullition, a greater range of thermometric readings can be obtained.

The apparatus represented by the annexed sketch illustrates one means whereby such an opposite pressure can be generated, and the boiling point of the mercury in consequence raised, the mercury being therefore maintained in a liquid condition at a higher temperature than is possible under normal conditions.

The instrument consists of two vessels in communication with one another by means of a tube of small bore. In one chamber is placed mercury, and in the second chamber alcohol or other elastic fluid. The two liquids—or the mercury and fluid—meet in the connecting stem at the base of a transparent tube, which forms part of the tube connecting the two chambers. The mercury on being subjected to heat expands, and in expanding compresses the elastic fluid, the amount of expansion being observed by means of the transparent tube referred to. The effect of such expansion is to generate a pressure, due to the compression of the elastic fluid, which pressure, re-acting on the mercury in the bulb, is the means of raising its boiling point,

MURRIE'S PATENT IMPROVED THERMOMETER.
FOR TAKING HIGH TEMPERATURES.



the limit being the strength and rigidity of the apparatus.

The sketch is self-explanatory. A great variety of apparatus can be constructed on these lines, a few of which I hope to bring under your notice on another occasion.

DISCUSSION.

Mr. COLEMAN: I quite agree with Professor Dittmar that temperatures can be taken by means of pressure gauges quite as easily as by direct measurements by increase of volume of liquid or gas, and also that such methods can be used either for high temperature or low temperatures. In reference to low temperature and the use of liquid sulphurous acid, it must be borne in mind that the sulphurous acid boils at only about zero F., and its use would be limited to temperatures above that point. If you wanted to get a little lower, say minus 100° F., you would require to use liquid carbonic acid; and if still lower you would require to use liquid ethylene or liquid oxygen, and so on; and further, you would require special instruments of such good construction as to be scarcely obtainable—whereas in taking an instrument like the one I have described to you, you not only get your accurate observations down to the lowest point you can possibly take it, but you always get the true thermodynamic scale.

Mr. BEILBY: I should like to ask Mr. Coleman if he finds it sufficiently accurate to treat the curve of mass of gas in the thermometer bulb at different temperatures as a straight line. In practical graduation I have always started from zero C., and worked upwards to the higher temperatures, laying down the *continuation* of the curve which may be supposed to start at absolute zero. This curve, from zero upwards, rapidly changes its curvature, and would only approximate to a straight line over short ranges of temperature. Mr. Coleman's method will, I fear, give considerable errors on the intermediate graduation between the two determined points if these are as much as 245 F. apart. The instruments which Professor Dittmar has so clearly described mark a new departure in thermometry. The principle on which they are based is so sure, and, in many respects, so well calculated to produce a sensitive and accurate thermometer, that we must hope that even if at present the instruments under trying conditions fail in respect of trustworthiness, yet the skill and perseverance of the makers will finally overcome the defect. The thermometer is such an important tool to scientific and technical chemists and physicists, that all good workmen will gladly adopt the best and keenest tool that can be supplied to them. My own interest in the subject originated in the deeply-felt want of a high temperature thermometer for use in practical researches on the distillation of paraffin oils at temperatures above the boiling point of mercury. If such an instrument had been ready to hand it would have saved much valuable time, and would have been gladly adopted; but on looking over all of the literature within my reach, I could light on no practical instrument, and I have not been able to hear of any such being in regular use. The *pressure* principle (of gases, not of saturated vapours), so warmly advocated by Professor Dittmar, was set aside on general as well as particular grounds. Notwithstanding the undoubted advantage of having the whole mass of gas always exposed to the temperature to be measured, instead of only a fraction, as in the *volume* thermometer, there always remains the fundamental difficulty of making an expansion bulb and connections which will remain perfectly gas-tight and retain their form and capacity under the *combined* influence of 500° C. (a temperature little, if at all, short of redness), and an over-pressure of 30lb. per square inch. It is most probable that this problem in construction will be solved for gases and for saturated vapours simultaneously. The most serious objection to the volume thermometer, that its degrees diminish in size with the diminishing mass of gas in the bulb, is to a certain extent removed in the instruments I have described by the measurement of the expelled gas at 100°; the scale up to 500° is thereby made a fairly open one.

Mr. COLEMAN, in reply, said that there could be no mistake about the method of graduating either Mr. Beilby's or his own air thermometer. If once the length of a degree at a fixed point, say 500° absolute, were determined—from the laws of thermo-dynamics, as soon as the temperature became one-half, that is, 250 absolute, the length of the degree would be double, not from the consideration of the curve of expansion of a known initial volume of air, but from the fact that the quantity of air in the thermometer bulb will always vary as the absolute temperature; and consequently, when the absolute temperature sinks to one-half of what it was at the start, the bulb contains twice as much air as at the start, and therefore the degrees on the stem must be double, and so on with any other arbitrary temperature we like to take.

Prof. DITTMAR suggested that the *constant volume* air thermometer, if properly contrived, might prove a handier instrument than the constant-pressure form adopted by the two gentlemen. The Bourdon manometer might be used for the measurement of the tensions; by means of it the ideal constancy of volume would be realized approximately without any trouble.

Mr. J. MURRIE: It has already been pointed out that the mercurial thermometer is liable to give wrong indications, particularly for comparatively high temperatures. I find from practice that the tension thermometer is just as liable to give inaccurate indications, due, I believe, to the pressure gauge not indicating the pressure correctly, especially when it is subject to variations of temperature; independent of this I have found it a difficult matter to get two Bourdon pressure gauges, connected to the same generator, to give exactly corresponding indications. Such variations, I believe, render the tension thermometer as liable to being inaccurate as the common mercurial thermometer.

Mr. STANFORD: I would like Mr. Murrie to answer one question which has already been mentioned to-night—viz., How the metal stands the action of the mercury at high temperatures?

Mr. MURRIE: I have made some experiments in order to see what action the metal had on the mercury and I find that it had literally no action, the mercury always returning to the same starting point.

Mr. T. L. PATTERSON, referring to the thalpotassimeters of Schäffer and Budenberg, said: Some years ago he had got one of these to try along with several others to determine the temperature of charcoal kilns. His idea was to put a pyrometer in each kiln to enable the fireman to keep it at a regular heat. At first the temperature that the pyrometer indicated was fairly good, but it soon fell off. He kept it in for several weeks, and at the end of three weeks the indication was about 200° below what the indication ought to have been. The reason for this was doubtless due to the great pressure which the mercury vapour exerted on the heated tube, causing it to expand and enlarge the chamber in which the mercury was held. In this way the pressure gradually fell, and consequently the temperature indication, so that it soon became useless. The falling off in pressure might also be due to diffusion of the mercury vapour through the red-hot walls of the tube, and to a slight leak at the joint,

which even with the best workmanship it was hardly possible to avoid. A graphite pyrometer subjected to the same conditions fell away in the same way, so that after being exposed to the heated gases of the kiln for three weeks the indication fell off 200° to 300° F., and by-and-bye the pointer stuck and would not move at any temperature. The pyrometers were tested by the method of specific heats, in which a platinum or copper ball was placed in the furnace until it had attained the same temperature, when it was quickly removed and dropped into a measured volume of water, in which the rise of temperature was noted by a thermometer. In this way the heat of a kiln was found to be, by copper balls at two trials—

1,359° F., and
1352·8° F.; mean = 1,355·9° F.;

while the graphite pyrometer at the same time indicated

1,020° F., and
1,150° F.; mean = 1,080° F.,

showing a wrong indication of over 275° F. The old copper rod pyrometer on the Daniell principle gave a better indication than either the thalpotassimeter or graphite pyrometer, but it needed to be often corrected. He thought that if any one wanted to get the proper temperature of furnaces, in which such delicate instruments as Mr. Beilby's could not be introduced, no matter how scientifically accurate they might be, the best method to use was that of specific heat, which was not difficult when one got into the way of it. Regarding the ether and water-tension thermometers, he had had no experience; but he feared the great pressure to which they were subjected would soon render their indications fallacious, as he had found with the mercury one. He was not aware that every refiner in Greenock used these. They were not in the refinery with which he was connected. Neither had he found any difficulty with thermometers often breaking, as Professor Dittmar had said. He knew of a thermometer being in a pan for 10 years without breaking, and he did not think any thalpotassimeter would live so long as that. No doubt thermometers did occasionally break, but they were now so well protected that this very seldom happened.

The Chairman: We are much indebted to Mr. Beilby for bringing before us the very important and almost universal form of air thermometer which he has exhibited; and to Professor Dittmar for showing us these excellent varieties of apparatus from Schäffer and Budenberg—names that are well known in most of our works in connection with pressure gauges. Our thanks are also due to Mr. Coleman for bringing before us what I really think will be *the* thermometer for registering low temperatures. It seems to me to be almost the only one that is likely to be accurate when you come to deal on the large scale with such temperatures as 200° below zero; and I expect to hear from Mr. Coleman, some evening later on, of very important practical results from this instrument, for I much doubt the accuracy of low temperatures, taken on the very small scale in which hydrogen and oxygen have been hitherto liquefied. We are also indebted to Mr. Murrie for his very ingenious high-pressure thermometer; he expects it to register up to 2,500°; and after what Mr. Patterson has stated about the difficulties of obtaining accurate results by pyrometers (which I think are admitted by every one), we shall look forward to having this instrument brought before us again in the more perfect form which Mr. Murrie has promised.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in the Construction and Arrangements of Desiccating Machines. W. A. Dyer. Eng. Pat. 10,816, July 31, 1884.

The object of this invention is the construction of a vacuum pan or desiccating apparatus in two compartments, so that the operation can be carried on in two stages; to provide means of agitating the material in the interior of the pan; a discharging door between the two parts of the apparatus so that they can be worked independently of each other; a discharging door in the lower part of the apparatus for the finished material; and an intercepting vessel for avoiding the ejection of material from the pan up the vapour outlet pipe. The apparatus is constructed in three pieces, a lower steam jacketed portion, a middle piece similarly jacketed and separated from the lower part by a jacketed deck, and a dome having an intercepting bell in its upper part. The usual outlet pipe to the condensor is provided and also communication pipes between the upper and lower parts of the pan. A vertical shaft having agitators and scrapers in each chamber is also shown passing through the stuffing boxes in each part of the pan. The doors for discharging the material from the upper deck to the lower, and also out of the pan, are worked from the exterior of the apparatus by suitable screws, worms and spur wheels. The usual pressure gauges, safety valves, steam and condensed water outlet cocks are shown. The patentee claims the various devices and their construction as above enumerated, in combination with desiccating machines by seven distinct claims.—C. C. H.

Improvements in Filtering Machines. J. A. Crocker, Boston, U.S.A. Eng. Pat. 12,694, Sept. 23, 1884.

The improved filtering apparatus consists of a casing resting upon trunnions on which it can swivel freely, and which serve, the one for an inlet for water to be filtered, the other as an outlet for the filtered water. The heads of the casing are hollow, that on the supply side conducting the water to the top of the apparatus, and that on the outlet side collecting the water after filtration. The filtering material occupies the central part of the machine placed between two gratings, which keep back the coarser impurities. The filter is cleansed by revolving it upon its trunnions, which changes the direction of the current, and carries the water containing the impurities, arrested by the filter, out by a waste channel. Matter difficult of removal from the gratings is either scraped off by scrapers working through a stuffing box from outside the filter, or it may be removed by the injection of steam. The whole machine and its several modifications and details are covered by 15 distinct claims.—C. C. H.

Improvements in Calcining Kilns. J. T. Raynes and B. D. Healy, Liverpool. Eng. Pat. 1,737, Jan. 19, 1884.

The subject of this invention is those kilns in which gaseous fuel is used, and in which lime, ores, &c., are burned. The gaseous fuel enters the interior of the calcining chamber at its base by means of flues running around the whole chamber, from which ports branch off into the chamber. Below this the furnace tapers to the drawing doors, at the outer end of which are gratings for screening the calcined material passing out of the furnace. The calcining chamber is divided into two or more parts by walls crossing it transversely, and these walls are furnished in their interior with gas and air flues. Cleansing doors and sight holes are also provided in suitable places, and the top of the furnace is mounted with a charging hopper and doors. The furnace is charged and set going with coal or coke in the well-known way, the gas is then admitted, and is brought in contact with the air as it issues into the furnace, the

air during its admission passing through the hot material discharged from the furnace. The patentees claim (1) the construction of a central partition, (2) providing the drawing holes with screens, (3) the construction of twin kilns, each part of which may be worked separately. —C. C. H.

Improvements in and relating to Evaporating Apparatus. H. H. Lake, London. Communicated by A. Vivien and D. R. Dujardin, Lille. Eng. Pat. 2,286. Jan. 28, 1884.

This invention relates to the construction of vacuum pans, and chiefly those of the class commonly known as "triple effect." The improvements consist of supplying the steam to the tubular heating surface by a pipe entering the upper or lower tube plate centrally, inserting a helical partition between the rows of tubes, so that the steam comes in contact with the whole of the tubes, circulating through the apparatus in a spiral form, removing the inert vapours in the tube partition of one pan, by suction, into the tube partition of the next pan, providing means for the removal of the condensed water in the tubes, so that by operating on the end pan of the series, the water in every pan is withdrawn simultaneously, providing a safety apparatus commonly known as "a save-all," formed in the top of the pan by two concentric pieces of tube forming dripping pieces on the central steam supply pipe, so as to prevent the projection of liquid along the surface of the tube; and lastly, in the formation of a condensor, wherein a cascade of water is formed by means of removable projections or trays. The invention and its various details are covered by 11 different claims.—C. C. H.

Improvements in Apparatus for Preventing Corrosion in Boilers and other Metallic Vessels. J. B. Hannay, Dumbarton. Eng. Pat. 2,927, Feb. 8, 1884.

The subject of this invention is an improved method of applying the apparatus already patented by the same author for the purpose set forth. Zinc blocks were therein suspended by means of conducting wires in the interior of the steam vessel to the metallic plates forming the shell of the vessel; the salts contained in solution were deemed sufficient to set up electric action. Some waters do not, however, contain sufficient sodium chloride to set up the desired action, and in certain cases the direct addition of the quantity requisite is inadmissible. In such cases the patentee proposes to inclose the "Electrogen" in the interior of an impermeable vessel, insulated from its sides, and packed round with crystals of salt; the conducting wire is carried through an asbestos stopper to the plates of the boiler. The patentee claims the application of zinc blocks enclosed as described for preventing corrosion in boilers.—C. C. H.

II.—FUEL AND LIGHT.

Improvements in the Manufacture of Clay Retorts. W. D. Cliff, Leeds. Eng. Pat. 13,188, Oct. 4, 1884.

The object of this invention is the production of retorts, to be used in coal gas manufacture, with a glazed interior, so that the carbon produced will not cling to their sides. Whilst the retort is in course of construction, and the clay is in the green state, the interior is faced with what is well known under the name of "porcelain body;" and, when completed, before being fired, a glazing material, of a nature depending upon the clay, is applied over the face of the first coating. The claim is:—Lining the interior of retorts as described so as to produce a glazed surface thereon.—C. C. H.

The Brown-coal of Istria and Dalmatia. Dingl. Polyt. Journ. 253 (13), p. 534.

Ladin (Annales des Mines) after discussing at length the geology of Istria and Dalmatia, states the results of five analyses of brown-coal. No. I. was coal from the Carpano-valley, taken from the bottom layers; No. II., from the same place, but after exposure to the air for some length of time; No. III. and IV., from the top layers; No. V., a general average sample.

	I.	II.	III.	IV.	V.
H_2O	1·46%	1·70%	1·57%	1·53%	1·56%
C	63·69	59·58	64·26	65·86	63·35
H	5·03	4·60	4·85	4·84	4·83
O	13·12	12·36	13·03	11·45	12·49
N	1·79	1·18	1·04	1·22	1·31
S	7·53	7·33	8·53	8·93	8·08
Ash	8·81	14·96	8·29	7·68	9·91
Total	101·46	101·71	101·57	101·51	101·56
Yield of coke	55·07	58·10	52·88	58·07	56·03

—S. H.

Improvements in Effecting Combustion of Liquid Hydrocarbons in conjunction with Water, Gas or Steam. J. H. Selwyn, London. Eng. Pat. 2160, January 25, 1884.

According to this invention liquid hydrocarbons are burnt in a furnace in conjunction with water gas or steam in presence of a substance containing both carbon and iron. In a previous patent (Eng. Pat. 4108, August, 1883) the arrangement of a furnace particularly adapted to resist the action of a continued high temperature, was described, this being capable of expansion and contraction, whilst remaining also to a certain extent air-tight. Thus by a careful regulation of the air supply carbon could be continuously formed from the hydrocarbon blown in, and fulfil a condition necessary to effect formation from steam of hydrogen (60%) carbonic oxide (20%) and carbonic anhydride (20%). To secure the constant deposition of carbon the inventor employs plumbago or graphite, which containing both carbon and iron is peculiarly adapted for the construction of furnaces of the above nature. The plumbago or graphite may be introduced into the furnace in the shape of bricks, linings or balls so as to render it possible to decompose the steam with which the hydrocarbon oil is blown in, and so to obtain a temperature of about 3776° F., such as may give the greatest quantity of gas for heating purposes. Iron being present the quantity of hydrogen produced is still further increased beyond the above named proportions, according to the following equation: $4H_2O + 3Fe = Fe_3O_4 + 8H$. The construction of the furnace is described in detail in the original specification.—D. B.

Improvements in the treatment of Coke and Peat. R. Smith Casson, Stafford. Eng. Pat. 1340, January 12, 1884.

To promote the rapid combustion of the carbon of coke or peat, and thereby produce a comparatively clear flame the patentee proposes to soak or otherwise thoroughly impregnate the combustible substances with petroleum or other oils or fatty or resinous substances.—D. B.

An Improved Process for Mixing with Earthy Matter and for Consuming as Fuel, Petroleum and other Hydrocarbons, and Apparatus for Carrying the same into effect. W. P. Thompson, Liverpool. Communicated by J. Leede of Washington and Granville H. Ouray, Florence, both in the U. S. A. Eng. Pat. 1864, Jan. 22, 1884.

In carrying out the first part of the invention, an apparatus is constructed consisting of a hopper for holding the granular or powdered material, provided with suitable conveyers for conducting the materials to the mouth of a vessel or furnace, a suitable tank for holding the hydrocarbon, provided with pipes, valves, etc., for conducting and regulating the flow thereof, under a head or pressure to the mouth of the furnace; a suitable blower to scatter and diffuse the hydrocarbon and solid materials and thereby cause a perfect admixture of the two. For carrying out the process of combustion additional means are provided for producing a gas or other jet flame near the mouth of the conduits and blast pipe, whereby the mixed fuel is ignited and consumed as it is scattered by the blast while in suspension. That part of the invention

which relates to the apparatus for feeding, igniting, and consuming pulverised fuel, saturated with petroleum, consists (1) in the combination of an automatic feed, means for producing a blast, and means for producing a jet flame, for igniting the fuel as it is projected away from the feed tube by the blast; (2) in the combination of a blower, a "carburettor" and a series of blast pipes for diffusing the fuel throughout the chamber and suspending it during combustion as well as for supplying oxygen; (3) in the combination of a series of blast pipes for igniting the fuel as it escapes and enters the fire chamber, and (4) in the combination of a series of adjustable pipes and valves for controlling the direction, force, and quantity of the blast without changing the speed of the blower. —D. B.

Improvements in Coke Ovens, and in Methods of and Apparatus for Collecting and Utilizing the Products of Combustion from such Coke Ovens. A. M. Chambers and T. Smith, York. Eng. Pat. 4708, March 11, 1884.

In the present invention a coke oven of the kind described in a patent obtained by A. M. Chambers in 1879 (Eng. Pat. 5,122) is constructed, its floor being somewhat inclined, so that it slopes gradually down towards the door of the oven. A sufficient number of channels or grooves, either open or covered, is made in the floor, all converging and leading to the lowest point, where they communicate with a pipe, which is carried down and led away to a condensing apparatus. The inventors remove or close the chimney or the flue leading to a chimney described in the specification already referred to, and connect the outer end of the pipe, which surrounds the crown of the oven, to air pumping machinery, by which air can be forced at any desired pressure into the pipe, and thence through the open end of the latter, after having been heated in its passage into the upper part of the oven. Thus the heated air by which sufficient combustion of the coal to effect coking is effected, and the products of combustion are compelled to pass downward through the mass of coal, and thence through the discharge pipe into the condenser. By this arrangement the products of combustion containing tar, heavy and light oils, ammoniacal liquor, and other valuable ingredients, which ordinarily escape by the chimney, and are wasted, are condensed and collected.—D. B.

Improvements in Apparatus for Extracting Ammonia and other Impurities from Coal Gas. J. Hanson, York. Eng. Pat. 16, January 1, 1884.

In order more effectually and expeditiously to wash or purify the gas passing through apparatus constructed to extract ammonia and other impurities from coal gas, a casing of metal plates or enamelled brick-work is formed, having man-holes formed therein, in suitable positions, and fitted with covers and connections. The apparatus is fixed vertically, and fitted with a blank bottom, having a stuffing box in the centre, through which pass two shafts, one of them hollow, and the other through the centre thereof, both shafts being stayed by journals in the interior of the apparatus, and supported by suitable footsteps. The shafts revolve in different directions, and are connected with frames fitted with wings at an angle for propelling the gas forward, and around the circumference of each frame is secured a circular brush for the purpose of making a joint between the frames and casing. A basket composed of three or more sections is placed on each frame, each section being fitted with fine wicker-work or strong open fibre, through which the ascending gas must pass. Above the centre shaft a grid is secured, having the bars fixed at an angle of about 45°, and above this grid a layer of porous pumice stone or coke is placed, over which is a cistern with a perforated plate secured thereto, containing a mixture of ammonia and water. The gas having passed through the revolving baskets, grid, etc., is met by a shower of ammoniacal water, supplied from the cistern above, through a valve on to the perforated place, where it is somewhat evenly distributed over the entire area of the apparatus, thereby keeping the scrubbing material constantly wetted, extracting the ammonia from the gas, the former running away from the basin to a store tank through a pipe connected therewith.—D. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Improvements in Processes and Apparatus for Dividing and Distilling Crude Petroleum, and for Refining the Products obtained. J. C. Mewburn, London. Communicated by the Halvorsen Process Company, New York. Eng. Pat. 12,498, September 17, 1884.

The process for the preliminary division of the crude oil consists in the separation of the latter into two portions, possessing distinct characteristics, called "primary oil" and "secondary oil." The average yield of the primary oil is about 35 per cent. The division is effected by mixing any quantity of the crude oil with commercial benzene, previously obtained from petroleum by distillation, using enough benzene to effect a complete separation. The mixture is placed in an open vessel, and the latter placed in a larger vessel. The benzene volatilizes and leaves the mixture, carrying with it the primary oil which drops into the larger outer vessel, the benzene itself passing off as vapour. After the benzene has all evaporated, it will be found that the crude petroleum has been divided, the inner vessel containing the secondary oil, and the outer vessel the primary oil. If the latter is to be employed as an illuminant no further treatment is necessary, but if it is to be used as a lubricant it is mixed with about one per cent. of amyl alcohol, and the mixture treated with ethyl alcohol, until it becomes milky or opalescent. The supernatant oil is drawn off, and the purified primary oil removed. The oil thus treated has a density of about 28° B. Only about one per cent. of each alcohol is usually needed to effect the removal of the small proportion of light hydrocarbons contained in the primary oil. This treatment imparts to the oil greater wearing qualities as a lubricant. The secondary oil has a density of about 36° B. It is subjected to fractional distillation as follows: The first distillate is naphtha, which is allowed to run until the temperature rises to about 120°. The receiver is then changed, and the distillation continued until the temperature reaches 288°. This second distillate is kerosene or burning oil. The receiver is changed again and the temperature raised to about 326°. This third distillate is a heavy burning oil, which the inventor calls "petro-sperm" oil. The residuum left in the still is a heavy oil, which makes a good lubricant. 100 parts of crude petroleum yield 35 parts primary oil (31° B.), 3 parts naphtha (65° B.), 40 parts kerosene (50° B.), 6 parts petro-sperm (36° B.), and 16 parts residuum (27° B.). No tar or waste products are obtained by this process. The purification of the kerosene is effected by adding to 95 parts of the latter 5 parts of sulphuric acid. The resulting "sludge" is allowed to subside; it is then drawn off, and the oil agitated with a small quantity of alcohol, which mixes or combines with the small portion of acid remaining in combination with the oil, and carries it to the bottom. The kerosene will now be clear, limpid, entirely free from fluorescence, neutral to test, and capable of enduring a flashing point of 54·4°. The petro-sperm oil may be purified in the same manner as the kerosene, and will stand a fire-test of 149°. It contains no paraffin, and does not form a crust on the wick when burned. It is like the kerosene, almost odourless. By first separating from the crude petroleum the "primary oil," the inventor claims the removal of the principal difficulties incident to petroleum distillation by the known methods, making this portion a most valuable illuminant and lubricant. The "secondary oil," on the other hand, becomes nearly as valuable as the entire quantity of crude petroleum, from which it is obtained, would ordinarily be owing to the improvement in the products obtained therefrom, their quantity, the ease with which it can be fractionally distilled, and the absence of waste products.—D. B.

IV.—COLOURING MATTERS AND DYES.

Process for the Manufacture of Naphthol Sulphonic Acids. Dingl. Polyt. Journ. 253 [13], p. 535. Brönner and Co., Frankfort-on-the-Maine.

In the preparation of β-naphthol, a β-dinaphthyl ether, $C_{20}H_{14}O$, is formed as a by-product, which, by treating with strong sulphuric acid at a high temperature, can be converted into a sulphonic acid of β naphthol, thus:

$$\beta\text{-}C_{20}H_{14}O + 4SO_4H_2 = 2\beta\text{-}C_{10}H_5OH(SO_3H)_2 + 3H_2O.$$

To prepare β-naphthol disulphonic acid, 1 part β-dinaphthyl ether is warmed with 3 parts sulphuric acid, containing 10 % anhydride, for 5 to 6 hours, at 110° to 120°C. The trisulphonic acid is obtained by heating 1 part β-dinaphthyl ether with 3 parts sulphuric acid, containing 10% anhydride, for 5 to 6 hours, at 110° to 120 C., adding 2 parts fuming sulphuric acid, containing 45 % anhydride, and heating to 140° to 150° C. for 3 or 4 hours more.—S. H.

Preparation of Brominized Azo-Colouring Matters. Dingl. Polyt. Journ. 252 [6].

According to the specification of the Société Anonyme des Matières Colorantes de St. Denis (Ger. Pat. Kl. 22, No. 26,642, December 14, 1882), all the colouring matters produced by the action of diazo compounds on phenols and amines or their sulphonic acids, are readily brominized, *e.g.*, 100 kilos. of the colouring matter produced by the action of para-diazophenyl sulphonic acid on β-naphthol in alkaline solution, are dissolved in 650 litres of water, and a solution of 62 kilos. sodium bromide, and 19 kilos. sodium bromate in 500 litres of water, is added. The whole is then acidified with 130 kilos. sulphuric acid, and at the end of the reaction, neutralized with a suitable base, such as potash, soda or lime, and the colouring matter is precipitated by common salt. The whole reaction occurs according to the equation—

$$5NaBr + NaBrO_3 + 6H_2SO_4 = 6NaHSO_4 + 3H_2O + 6Br.$$

—F. L. T.

On Azoresorcinol and Azoresorufinol. Heinrich Brunner and Charles Krämer. Berl. Ber. 17, 1847.

The authors find that the same colouring matter, Weselsky's diazoresorufinol, is produced by acting on resorcinol with Liebermann's reagent (a solution of nitrous anhydride in sulphuric acid), with Weselsky's reagent (a solution of nitrous anhydride in nitric acid, employing a dilute ethereal solution of resorcinol), and with nitrobenzene and sulphuric acid, but that other colouring matters are formed when different phenols are treated with the same reagent. The authors' results confirm those of Liebermann, but differ in some cases from Weselsky's, and they propose to name Weselsky's diazoresorcinol and diazoresorufinol, azoresorcinol and azoresorufinol respectively.

Azoresorcinol $C_{12}H_9NO_4$. The substance was prepared according to Weselsky's directions by treating a solution of 4grm. resorcinol in 300c.c. of ether with 40 to 50 drops of nitric acid, saturated at 0° C. with nitrous anhydride. The azoresorcinol formed, after recrystallization from glacial acetic acid, small lustrous cantharides green coloured crystals, which gave with alkalis a blue-violet solution with brown fluorescence. The crystals are insoluble in water and ether, and but slightly soluble in alcohol. Eight analyses gave the formula $C_{12}H_9NO_4$, and not $C_{18}H_{12}N_2O_6$ or $C_{18}H_{10}N_2O_6$ as proposed by Weselsky. The authors maintain that the reaction takes place in two stages; the resorcinol is first converted by the nitrous anhydride into nitrosoresorcinol, and the oxygen of the nitroso group then combines with the two hydrogen atoms of the hydroxyl groups of another molecule of resorcinol forming water and azoresorcinol, thus:

$$(HO)_2C_6H_3N = \boxed{O + \begin{matrix} H \\ H \end{matrix}} \begin{matrix} O \\ O \end{matrix} > C_6H_4 = H_2O +$$

$$(HO)_2C_6H_3N < \begin{matrix} O \\ O \end{matrix} > C_6H_4.$$

Azoresorufinol $C_{24}H_{16}N_2O_7$. Prepared (*a*) by Weselsky's method by heating one part of azoresorcinol with 25 parts of concentrated sulphuric acid to 210°, and pouring the violet solution into water. (*b*) By Liebermann's method, by dissolving 5grms. of resorcinol in 15c.c. of concentrated sulphuric acid, and adding gradually 40grms. of the reagent. The mixture was heated to 140°, and poured into cold water. (*c*) According to Bindschedler and Busch, by warming nitrosoresorcinol with resorcinol and concentrated sulphuric acid. (*d*) By Brünner's method, by heating 5grms. resorcinol, 2·5grms. nitrobenzene and 75grms. sulphuric acid to 170°. The yield by this process was, however, extremely small, para-amido-phenol-sulphonic acid being formed in larger quantity. Azoresorufinol prepared by any of these methods forms a red-brown powder, insoluble in water and ether, and difficultly soluble in alcohol. It dissolves in concentrated sulphuric acid, forming a blue-violet solution of the sulphonic acid, which is decomposed by water. With alkalis it forms a carmine-red solution with a cinnabar coloured fluorescence, the intensity of which is so great that azoresorufinol appears to be the most delicate indicator for alkalis. The composition was proved by 12 analyses. In the formation of the substance two molecules of azoresorcinol lose one molecule of water, giving an anhydride thus:

$$2(C_6H_3(OH)_2\text{-}N(O_2)''C_6H_4) = H_2O + \begin{matrix} C_6H_3(OH)\text{-}N(O_2)''C_6H_4 \\ >O \\ C_6H_3(OH)\text{-}N(O_2)''C_6H_4 \end{matrix}$$

Weselsky on the other hand gives the following equation:

$$2(C_{18}H_{12}N_2O_6) = 3H_2O + C_{36}H_{18}N_4O_9. \quad \text{(Annalen 162·273).}$$

When nitrobenzene and resorcinol are treated with a small quantity of sulphuric acid azoresorufinol is not formed, but a mixture of compounds with green and blue fluorescence, identical with the ethereal condensation products of resorcinol discovered by Barth and Weidel (Berl. Ber. 10, 1469). Pure nitroethane gives no colouring matter with resorcinol and sulphuric acid. Di- and tri-nitrohydrocarbons and di- and tri-nitrophenol do not give colouring matters with resorcinol and other phenols, but only the mononitro compounds. This affords a further confirmation of the formulæ and method of formation of these colouring matters.

Action of Acetyl Chloride on Azoresorcinol. Weselsky obtained a compound to which he gave the formula $C_{48}H_{30}N_4Cl_8O_{15}$, describing it as hexacetyl-azoresorufinol in which each nitrogen atom is combined with two chlorine atoms. The authors obtained the substance in the form of gold-yellow lustrous scales, soluble in sulphuric acid and alkalis, forming a blue solution, which became violet on warming. The formula was found to be $C_{12}H_9Cl_2NO_3$, and the authors describe the compound as the hydrochloride of the body $C_{12}H_8ClNO_3$, and give it the constitution $C_6H_3.OH(Cl)NHCl(O_2)''C_6H_4$.

Its formation takes place thus—

$$C_{12}H_9NO_4 + HCl = H_2O + C_{12}H_8ClNO_3.$$

Azoresorcinol and Azoresorufinol combine, not only with bases, but also with acids to form salts, and therefore the nitrogen must be trivalent in these compounds. Only one molecule of hydrochloric acid combines with each atom of nitrogen, and the chlorine precipitates silver from silver nitrate. The mother liquor from the yellow crystals yielded, on evaporation and treatment with alcohol, an amorphous greenish lustrous substance, a derivative of azoresorufinol, which formed with alkalis a red solution with cinnabar coloured fluorescence. Its composition was found on analysis to be $C_{26}H_{21}N_2Cl_3O_6$ or $C_{24}H_{14}(C_2H_5)ClN_2O_6 + 2HCl$, and the authors give it the constitution—

$$\begin{matrix} \overset{\text{v}}{C_6H_4(O_2)''N}.HCl.C_6H_3.OC_2H_5 \\ \text{v} \qquad >O \\ C_6H_4(O_2)''N.HCl.C_6H_3.Cl \end{matrix}$$

By heating with acetic anhydride and anhydrous sodium acetate diacetyl-azoresorufinol was obtained. Its composition $C_{24}H_{14}(C_2H_3O)_2N_2O_7$ or

$$\begin{matrix} C_6H_4(O_2)''N - C_6H_3 - O.C_2H_3O \\ >O \\ C_6H_4(O_2)''N - C_6H_3 - O.C_2H_3O \end{matrix}$$

was proved by analysis. By heating with alkalis azoresorufinol was reformed. Azoresorufinol hydrochloride, $C_{24}H_{14}Cl_2N_2O_5.2HCl$, was prepared by heating azoresorcinol with fuming hydrochloric acid to 100°, thus—
$2(C_{12}H_9NO_4) + 4HCl = C_{24}H_{14}Cl_2N_2O_5.2HCl + 3H_2O$.

Hydrochloride of hydro-azoresorufinol ether. Azoresorcinol and azoresorufinol give the same reduction product with nascent hydrogen both in acid and alkaline solution. By warming azoresorcinol with tin and concentrated hydrochloric acid the compound described by Weselsky as hydro-diazoresorufinol is formed. It occurs in colourless scales like mother of pearl, which, on standing in the air, assume the colour and coppery lustre of sublimed indigo, and which, on oxidation, are easily converted into azoresorufinol. The formation of the substance resembling indigo depends on the loss by the crystals of hydrochloric acid and water of crystallization. The latter could not be determined directly for the substance decomposes at 100°. The composition of the compound was found on analysis to be $C_{48}H_{46}N_4O_{13} + 4HCl + 4H_2O$. When dried quickly on the water bath the crystals yield a blue powder, from which crystals, resembling potassium permanganate, may be obtained. When crystallized from alcohol the composition was found to be $C_{48}H_{46}N_4O_{13} + 3HCl$, and from acetone $C_{48}H_{46}N_4O_{13}.HCl$. The formation of the compound is thus described: Azoresorcinol loses water and forms azoresorufinol; the same process is repeated, two molecules of azoresorufinol losing one molecule of water, and forming an ether thus—

$$2\left\{\begin{array}{l} HO-C_6H_3-N(O_2)''C_6H_4 \\ \quad O \\ HO-C_6H_3-N(O_2)''C_6H_4 \end{array}\right\} = H_2O +$$

$$\begin{array}{l} C_6H_4(O_2)''N-C_6H_3 \text{———} O \text{———} C_6H_3-N(O_2)''C_6H_4 \\ \qquad\quad O \diagup \qquad\qquad\qquad\qquad \diagdown O \\ C_6H_4(O_2)''N-C_6H_3-OH \quad HO-C_6H_3-N(O_2)''C_6H_4 \end{array}$$

And this ether takes up 16 atoms of hydrogen. The formation of Barth and Weidel's di- and tetraresorcinol ethers is analogous to the above. In the reduction process probably each benzene group takes up two atoms of hydrogen, and the nitrogen combines with hydrochloric acid. Dilute alkalis in presence of air convert the substance first into azoresorufinol, and finally into azoresorcinol.

Tetrahydrazoresorufinol, $C_{24}H_{16}N_2O_7.H_4$. This compound is prepared by the action of zinc and concentrated hydrochloric acid on azoresorcinol in the form of dark blue crystals with coppery lustre. At 100° it is converted into azoresorufinol. The hydrochloride $C_{24}H_{20}N_2O_7.2HCl$ was analysed. The same compound is formed by the action of hydrogen sulphide on an ammoniacal solution of azoresorufinol. With sodium amalgam azoresorcinol yields a very unstable leuco-compound, which is colourless, but rapidly assumes an indigo-blue colour in contact with the air.

Dibromo-azoresorcinol hydrobromide,

$$C_{12}H_7Br_2NO_4.HBr,$$

was prepared by dissolving azoresorcinol in caustic soda, and saturating the solution with bromine in the cold. A brown precipitate was produced, which on recrystallization from alcohol, yielded a cantharides-green lustrous mass. The substance was analysed.

Hexa-bromo-azoresorufinol hydrobromide,

$$C_{24}H_{10}Br_6N_2O_7.HBr.$$

This compound was prepared like the one last described, from azoresorufinol, but the mixture was warmed. It forms a red amorphous mass, which gives with alcohol a violet solution with blood-red fluorescence. The composition was proved by analysis.

Tri-nitroazoresorcinol, $C_{12}H_6(NO_2)_3NO_4$. According to Weselsky azoresorcinol and azoresorufinol yield tetrazo-compounds with concentrated nitric acid, but his results were not confirmed by those of the authors. The action of nitric acid is very violent, and great care must be taken to prevent loss. Weselsky's tetrazoresorcinol nitrate—

$$C_{36}H_{12}\overset{IV}{N_5}O_{12}.6NO_3$$

is described by the authors as tri-nitroazoresorcinol, $C_{12}H_6(NO_2)_3NO_4$, and his tetrazoresorufinol nitrate, $C_{36}H_6N_4O_4 + 6NO_3 + 11H_2O$, as hexa-nitroazoresorufinol, $C_{24}H_{10}(NO_2)_6N_2O_7$. The first compound was obtained in the form of small lustrous cantharides-green crystals. The alcoholic solution has an indigo-blue colour. The second compound was prepared from azoresorufinol, and formed fine cantharides-green needles, dissolving in water, alcohol and ether, with a purple colour. A complete analysis of the first compound was made, and the nitrogen in the second determined. By the action of tin and hydrochloric acid on the nitro-compounds the authors obtained amidoazoresorcinol, amidoazoresorufinol, and amido-derivatives of the hydroazoresorufinol ethers.—S. Y.

On the Amidophenol Sulphonic Acids and their Relation to Liebermann's Colouring Matters. Henrich Brunner and Charles Krämer. Berl. Ber. 17, 1867.

When nitrobenzene and resorcinol are heated with concentrated sulphuric acid to 160–170°, azoresorufinol and para-amidophenol-sulphonic acid are formed. The mixed precipitate was dissolved in warm ammonia, and precipitated while hot with hydrochloric acid. The azoresorufol separated at once, and the acid crystallized from the filtrate after cooling in white lustrous needles. After recrystallization from hot water they were analysed, and the composition was found to be

$$C_6H_3(OH)NH_2.SO_2OH.$$

The solution of the crystals in water or alcohol reduces an ammoniacal solution of silver nitrate in the cold, and gives a violet colour with ferric chloride. The crystals become brown in contact with the air.

Nitrobenzene alone does not give the acid when heated with concentrated or fuming sulphuric acid, hence the azoresorufinol must be concerned in its formation. In the production of Liebermann's colouring matters from nitrosophenols, the oxygen of a nitroso-group appears to combine with two hydrogen atoms of the hydroxyl groups of one polyvalent or two mono- or polyvalent phenol molecules to form water, so that the colouring matters contain the groups

$$C_6-N \begin{array}{c} O \\ O \end{array} C_6 \text{ or } C_6-N \begin{array}{c} O-C_6 \\ O-C_6 \end{array}$$

Since azoresorcinol is formed from nitrosoresorcinol and resorcinol, thus:—

$$\begin{array}{l} \begin{array}{c} HO \\ HO \end{array} C_6H_3N:=:O \quad \begin{array}{c} HO \\ HO \end{array} C_6H_4 = H_2O \\ + \begin{array}{c} HO \\ HO \end{array} C_6H_3N \begin{array}{l} \diagup O \\ \diagdown O \end{array} C_6H_4. \end{array}$$

When nitrobenzene and resorcinol are heated with concentrated sulphuric acid, a transposition of atoms must occur, the nitrobenzene yielding para-nitrosophenol and the divalent radical $\begin{array}{c} HO \\ HO \end{array} \rangle C_6H_3N=$, thus:—

$$2C_6H_5N \begin{array}{l} \diagup O \\ \diagdown O \end{array} = C_6H_4(\overset{1}{O}H)\overset{4}{N}O + \begin{array}{c} HO \\ HO \end{array} \rangle C_6H_3N=.$$

Sulphur dioxide is evolved, and thus nascent hydrogen may be produced. The oxygen of a nitroso group unites with the hydrogen of resorcinol to form water, the resulting group $C_6H_4(\overset{1}{O}H)\overset{4}{N}=$ combining with hydrogen to form para-amidophenol, while the divalent radical $(OH)_2C_6H_3N=$ combines with the group $\begin{array}{c} -O \\ -O \end{array} C_6H_4$ formed from resorcinol, and yields azoresorcinol; thus:—

$$\left.\begin{array}{l} (HO)_2C_6H_3N= + \begin{array}{c} HO \\ HO \end{array} \rangle C_6H_4 \\ \\ C_6H_4(OH)N = O \qquad + H_2 \end{array}\right\} = H_2O$$

$$+ (OH)_2C_6H_3N \begin{array}{c} O \\ O \end{array} \rangle C_6H_4 + C_6H_4(\overset{1}{O}H)\overset{4}{N}H_2.$$

The sulphuric acid then forms the sulphonic acid of para-amidophenol and converts azoresorcinol into azoresorufol.

The action of the homologues of nitrobenzene and of the three isomeric nitrophenols on resorcinol and sulphuric acid was studied.

Paranitrotoluene and resorcinol yielded a dimethyl ether of azoresorufinol, and para-amidophenol-sulphonic acid. The conversion of the ethyl groups of the benzene ring into methoxyl groups in the formation of azoresorufol dimethyl ether is surprising, the more so as in the amidophenol sulphonic acid the ethyl group is liberated. In the formation, however, of the amidophenol sulphonic acid from nitrobenzene or nitrotoluene, an oxygen atom is transferred from the nitro group to the carbon atom in the para-position, and the authors consider it certain that a dimethyl ether, and not an isomeric dimethylazoresorufinol is formed.

Neither ortho- nor meta- but only paranitrophenol give with resorcinol colouring matters resembling azoresorufinol, while para-amidophenol sulphonic acid is formed as a by-product in each case. Hydroquinone and pyrocatechol do not give colouring matters either with nitrobenzene or nitrous acid, but they do yield amidophenol-sulphonic acids.

From the authors' researches it appears also that only mono- and not dinitrosophenols yield colouring matters. Thus mononitrosoresorcinol and mononitroso-orcinol give colouring matters with resorcinol and orcinol, while Fritz's dinitrosoresorcinol (Berl. Ber. 8, 631) and Stenhouse's dinitrosoorcinol (Annalen 188, 353) give no colouring matters with resorcinol and orcinol. These facts afford a further proof that the phenol colouring matters contain the trivalent group $-N=O=$, combined with two or three benzene rings, and not two atoms of nitrogen to 12 or 18 atoms of carbon.

Para-amidophenol sulphonic acid and phenol colouring matters.—When the acid is heated, a small quantity of a dark violet sublimate is formed. In its properties it cannot be distinguished from Liebermann's phenol colouring matter $C_{18}H_{15}NO_3$. Its formation may be explained thus:—

$$3C_6H_3(OH)NH_2.SO_2OH = 3SO_3 + 2NH_3 + C_{18}H_{15}NO_3.$$

The ortho- and meta-amido phenol sulphonic acids when subjected to dry distillation yielded no trace of colouring matter.

(a) Amidoresorcinol-sulphonic acid and azoresorcinol.—The yellow non-volatile nitroresorcinol, melting at 115°, which, according to Weselsky and Benedikt, has the constitution 1 : 3 : 4, was converted into the corresponding amidosulphonic acid. Green glittering scales were obtained, but Hazura describes the acid as occurring in reddish prismatic crystals. When heated in a glass tube a dark violet sublimate of either azoresorcinol or azoresorufinol was obtained, according to the temperature, thus:—

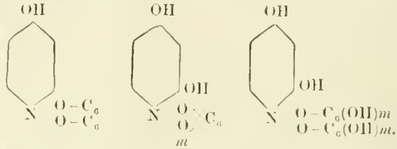
$$2C_6H_2(\overset{1}{O}\overset{3}{H})_2.\overset{4}{N}H_2.SO_2OH - 2SO_3 + NH_3 + H_2 + C_{12}H_9NO_4$$

or

$$4C_6H_2(OH)_2.NH_2.SO_2OH = 4SO_3 + 2NH_3 + 2H_2 + H_2O + C_{24}H_{16}N_2O_7.$$

(v) Amidoresorcinol-sulphonic acid.—The red volatile nitroresorcinol to which Weselsky and Benedikt give the constitution 1 : 2 : 3 was converted into the amidosulphonic acid which crystallized in colourless prisms. On heating this acid no colouring matter was obtained.

The authors draw the following conclusions from their results with regard to Liebermann's colouring matters. Since (1) only paranitrophenol, para-amidophenol sulphonic acid, and para-amidoresorcinol sulphonic acid (also paranitrotoluene) and not the corresponding ortho- and meta-compounds yield colouring matters; (2) of the diatomic phenols only resorcinol and neither hydroquinone nor pyrocatechol yield colouring matters; (3) nitrosoresorcinol and nitroso-orcinol yield colouring matters when heated with resorcinol or orcinol and concentrated sulphuric acid, but not when heated with hydroquinone or pyrocatechol; it follows that in Liebermann's colouring matters the nitrogen atom occupies the para position with regard to a hydroxyl group, and that of the polyatomic phenols only those in which the hydroxyl are in the meta position can form the colouring matters. The following characteristic groups are therefore present in these substances:—



—S. Y.

Improvements in the Manufacture or Production of Colouring Matters from the Tetrazo-compound of Benzidine Disulphonic Acid. John Peter Griess, Burton-on-Trent. Eng. Pat. 1074, January 9, 1884.

The disulphonic acid mentioned (which is the disulphonic acid of diamido-diphenyl) is diazotised and combined with the naphthylamines and methylphenyl, or naphthyl naphthylamines, and their sulphonic acids. As an example is given the action of the tetrazo compound upon naphthionic (α-naphthylamine-sulphonic) acid, which takes place in neutral or alkaline solution with the production of a red dye stuff which has the property of dyeing cotton goods without the use of a mordant.—R. M.

Improvements in the Manufacture or Production of Colouring Matters obtained from Sulpho-derivatives of Benzidine, and in the Preparation of such Sulpho-derivatives. John Peter Griess, Burton-on-Trent. Eng. Pat. 1099, January 9, 1884.

Four new sulphonic acids of benzidine are described:—

$C_{12}H_5(NH_2)_2(HSO_3)_3$ Benzidine trisulphonic acid.
$C_{12}H_4(NH_2)_2(HSO_3)_4$ Benzidine tetrasulphonic acid.
$C_{12}H_5(NH_2)_2(HSO_3)SO_2$ { Benzidine sulphone monosulphonic acid.
$C_{12}H_4(NH_2)_2(HSO_3)_2SO_2$ { Benzidine sulphone disulphonic acid.

All of these acids are produced by heating sulphate of benzidine with three to four parts of fuming sulphuric acid to 170° to 200 C. for one hour, taking care that charring does not take place. The mixed acids can be separated from one another by fractional extraction with water, or by converting them into calcium or barium salts and crystallizing; but in practice the mixture of acids can be made use of, although the author finds it preferable to convert the sulphone monosulphonic into the corresponding disulphonic acid, owing to the superiority of the dyes from the latter. The remainder of the process is similar to that described in the foregoing specification, the benzidine sulphonic acids being diazotised and combined with amines and phenols, and their sulphonic acids. A typical illustration of the process is given for producing a dark cotton-red from tetrazo-benzidine trisulphonic acid and β-naphthol in alkaline solution.—R. M.

Improvements in the Manufacture of several Monosulphonic Acids of β-Naphthylamine. Emil Elsasser, Barmen. Eng. Pat. 7742, May 14, 1884.

β-Naphthylamine is dissolved in three times its weight of fuming sulphuric acid, containing 15 to 20 per cent. of anhydride, and heated to 70° to 75° C., till a sample remains clear on dilution and the addition of ammonia. The melt is diluted with five times its weight of cold water and filtered to remove the more difficultly soluble monosulpho acids, which, after being pressed, are converted into sodium salts. This insoluble acid is stated to consist of three modifications, which are separated in the following way:—The dried sodium salt is digested for an hour with 93 to 96 per cent. alcohol, and filtered. The residue consists of the sodium salt of

the monosulpho acid No. I., and the filtrate containing the other two modifications is evaporated, dissolved in water, and the sulpho acid precipitated by hydrochloric acid, and then converted into Ca or Ba salts. The solution of these salts is allowed to crystallize when the salt of acid No. II. first separates out in small quantity and the solution contains the new acid No. III., which, in the free state, is very difficultly soluble in water. Other methods of producing and separating these isomeric acids are described.—R. M.

Improvements in the Manufacture of Red Azo Dye Stuffs or Colouring Matters. Emil Elsässer, Barmen. Eng. Pat. 7713, May 14th, 1884.

This invention relates to the preparation of azo-colours from the new β-naphthylamine monosulphonic acid No. III., or from mixtures of the acids II. and III., described in the previous specification. The acids are diazotised in the usual way, and combined with "the α-naphthol sulpho acids obtained from Piria's naphthionic acid and Laurent's sulpho-naphthalidamic acid (*i.e.*, the α-naphthol monosulphonic acids may be obtained from naphthionic acid or sulpho-naphthalidamic acid)."—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, &c.

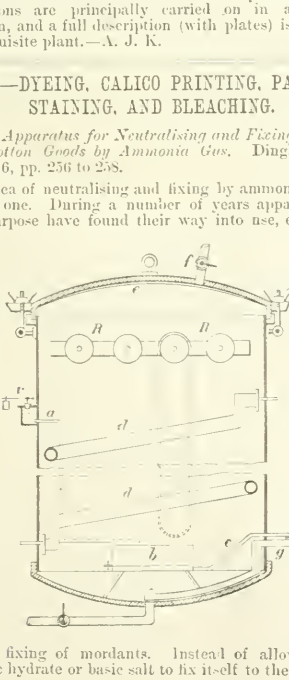
A New or Improved Process of Scouring and Washing Wool and other Materials, and Apparatus for the Purpose. Ernest de Pass, London. Eng. Pat. 973, January 8, 1884.

This patent refers to a process of thoroughly scouring and washing wool and certain other raw material. It entails the use (1) of a solvent of fatty bodies, other than sulphuret of carbon, preferably toluene, (2) of water as a solvent of substances other than fatty bodies. The operations are principally carried on in a rarified medium, and a full description (with plates) is given of the requisite plant.—A. J. K.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Diehl's Apparatus for Neutralising and Fixing Colours in Cotton Goods by Ammonia Gas. Dingler [252], Heft 6, pp. 256 to 258.

The idea of neutralising and fixing by ammonia gas is an old one. During a number of years apparatus for this purpose have found their way into use, especially



for the fixing of mordants. Instead of allowing the metallic hydrate or basic salt to fix itself to the fibre by slow evaporation of acetic acid, the idea is to precipitate it by a direct chemical neutralisation.

O. Diehl (Ger. Pat., Kl. 8, No. 21077, March 14, 1882), has specified an ammonia apparatus. The goods on which the printed colours are to be neutralised or fixed, are wound on to rollers R, which can be set into slow motion from the outside. The apparatus is then closed tight. By lifting the safety valve *v*, ammonia solution is poured through the tube *a*, into the small double-bottomed evaporation pan *b*, and evaporated by means of steam through the tube *c*. The apparatus is at the same time warmed by the worm *d*, whereby the condensation of water during the work is prevented. The plate *e* is placed to receive any water condensed on the roof, and prevent it injuring the goods. At the end of the reaction, in order to remove the last traces of ammonia, steam is blown in at the pipe *g*, leaving by the cock *f*.—F. L. T.

An Improved Process for Colouring Paper in Endless Rolls, and in Apparatus to be Employed Therewith. W. H. Beck, London. Eng. Pat. 12372, Sept. 13, 1884.

The above title contains all the information that can profitably be abstracted from this specification, which is accompanied with drawings.—A. J. K.

Improvements in the Printing of Indigo upon Textile Fabrics. G. H. Underwood, Manchester. Eng. Pat. 421, January 2, 1884.

The surface of the textile fabric is "padded" or printed with a sulphide of arsenic, either thickened with starch or in solution of an alkali or alkaline carbonate. The cloth thus mordanted is now printed with the following preparation of indigo:—Commercial indigo is ground with water or alkali to the consistency of a thick paste; to this is added thickening material, such as British Gum or starch, and to the whole, when thoroughly stirred, is further added a strong solution of caustic soda, which is also thoroughly mixed in with the other ingredients to form a uniform paste, which is used for printing. By subjecting the cloth thus prepared and printed to the action of steam, the indigo becomes deoxidised to indigo-white. In the subsequent processes of ageing, scouring, and washing the indigo re-absorbs oxygen, and is finally printed blue upon the cloth. —A. J. K.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Manufacture of Glass. Dingl. Polyt. Journ. 253 (13), p. 529.

For the manufacture of a marble or jasper-like glass (Weiskopp & Co., Morchenstern in Bohemia, Ger. Pat. 27087, 1883), fuse 100 parts sand with 3 parts sodium sulphate, 4 parts iron peroxide, 12 parts plumbago or charcoal, 36 parts sodium carbonate, 12 parts lime, and 12 parts potassium carbonate. In order to decorate the glass, 1 part silver sulphide and 5 parts iron peroxide are employed, whereby especially dark green lines come into prominence. One part silver sulphide and from 5 to 10 parts manganese peroxide produce dark brown lines.

The invention of M. N. Schmitt, Ringen (Ger. Pat. 26161, 1883), relates to producing a permanent silver polish on bottles for wine, liquor, etc. Aluminium is dissolved in concentrated hydrochloric acid, and a coating of that solution applied on the bottles. They are then heated, whereby they assume a silvery appearance. According to another process, fine washed pure alumina, in the form of a paste, is laid on the bottles. They are then heated, and carbon bisulphide is made to pass over them so long until all alumina is converted into aluminium sulphide (?), when a silvery surface will make its appearance.

A. Schierholz, Plauen (Ger. Pat. 26080, 1883), decorates glass by applying a coating of syrupy enamel on a certain spot, then covers it with small beads and burns

them in the glass. In the same manner so-called cathedral glass can be made.

W. B. Fitch, Deptford (Ger. Pat. 26693, 1883), recommends for decorating glass goods with enamel, passing them before cooling down in the cooling furnace across a revolving asbestos-roller, which is covered with a hot enamel mass. On certain raised spots the enamel is taken up, which hardens and adheres firmly to the glass after passing through the cooling furnace.—S. H.

X.—METALLURGY, MINING, ETC.

Recent Improvements in Metallurgical Operations. Dingl. Pol. Journ. 253 (12), p. 505-509.

G. v. Giesche, Breslau (Ger. Pat. 25069, 1883), roasts blende by heating it at first moderately in a couple of burners *n* (fig. 1 and 2) which are supplied with air by a into the bottom kiln *c* to be roasted at a high temperature. The burners *n* are then again charged with fresh ore through the doors *a*.

J. v. Miskey (Oesterr. Zeitschr. für Berg- und Hüttenwesen 1883, 521) proposes to employ a regenerative furnace for lead-smelting. If the slides *F* and *f* have the position as represented in fig. 3, 4 and 5, air is drawn into the regenerators *h* through the open channel *k* owing to the aspirating action of the chimney, connected with the flue *g*. Having taken up heat on its course through the channels *h* on the left side, the air passes over the bridge *o* and the hearth *a*, where it gives off a considerable portion of its heat and proceeds over the opposite bridge into the chamber *b* to mix here with producer gas, coming from *c*. The heat of the combustion taking place here is employed to heat the channels *h* on the right side, through which the gases escape on their way to the chimney. By moving the slides *F* and *f* the direction of the gases can

Fig. 1.

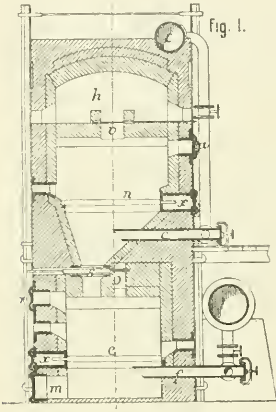
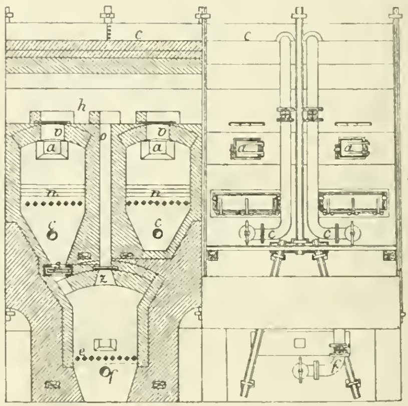


Fig. 2.



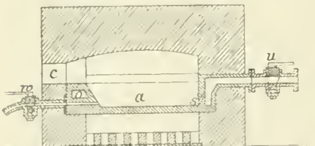


Fig 3.

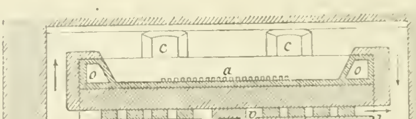


Fig 4

Körting's injector. Slides *s* separate these burners from the kiln *c* which is worked with hot air. The gases generated here are rich in sulphurous acid compared with those produced in the top kilns. All gases, however, meet in the main-flue *h* and the mixture is said to be rich enough for making oil of vitriol with advantage. When the roasting of the blende in *c* is complete, it is discharged and, by withdrawal of the slide *s*, the charge in *n* falls be reversed. For the manufacture of metallic lead a layer of liquid lead, 10 to 15cm. high, is first made on the hearth *a* and galena is afterwards introduced. The impurities collecting on the surface are removed with a scoop. By opening the tap *u* air is pressed through the small openings *s* at the bottom of the hearth into the molten lead, which is hereby oxidised. The oxide of lead mixes intimately with the galena and at the end of the

operation metallic lead can be drawn off by the tap *w*.

L. Neuendahl, Breslau (Ger. Pat. 27164, 1883), has

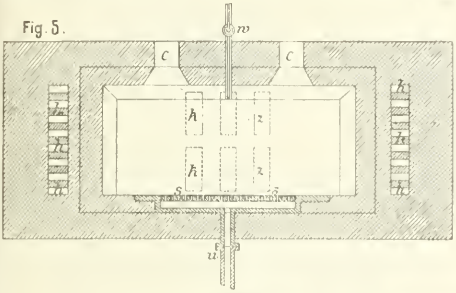


Fig. 5.

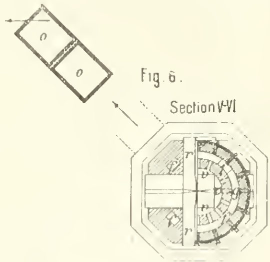


Fig. 6. Section V-VI

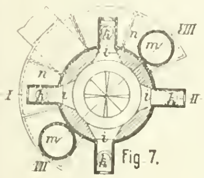


Fig. 7. Section III-VI.

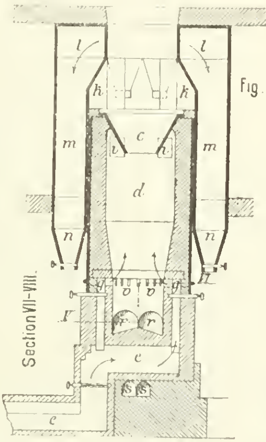


Fig. 8. Section VII-VIII.

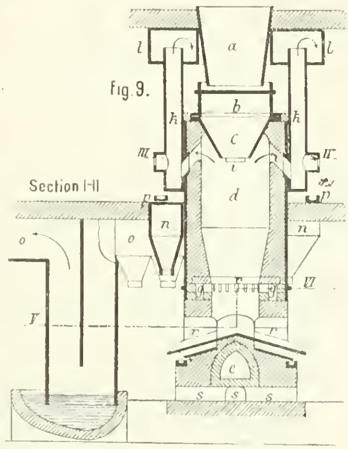


Fig. 9. Section I-II

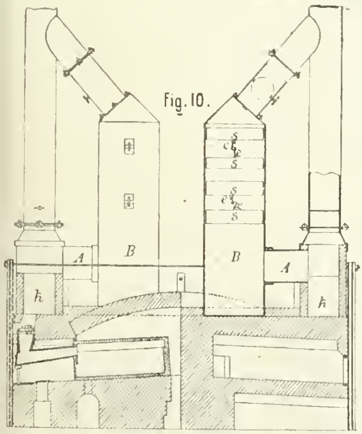


Fig. 10.

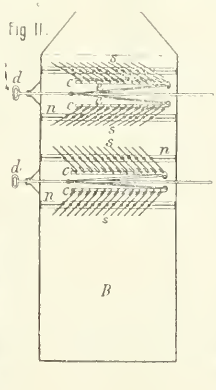


Fig. 11.

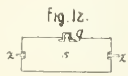


Fig. 12.

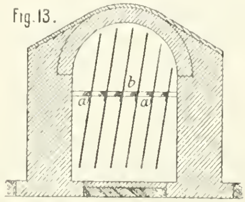


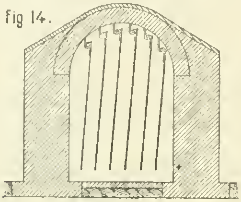
Fig. 13.

patented a shaft furnace for making both zinc and lead from plumbiferous zinc ores. The mixture of ore and coal is charged into the iron hopper *a* (figs. 6, 7, 8 and 9) whence it gradually sinks down into the shaft *d*. Producer gas enters the furnace at the bottom and after passing through the red-hot layer of ore escapes along with the metal vapours through a series of fireclay receivers and iron condensators, which condense the zinc, into the chimney. The charge deprived of its zinc gra-

dually reaches the working doors and is withdrawn at regular intervals. The object of this mode of working is to avoid the admission of air in excess, which would act oxidising on the zinc vapours in the top part of the furnace. Along with the producer gas just sufficient air is introduced into the furnace to produce the combustion of the gases. The reduced lead drops on a fireclay hearth at *r*, thence in a gutter, and is collected in boxes placed below.

L. Kleemann, Mislowitz (Ger. Pat. 26789, 1883) describes a condensation arrangement for zinc furnaces. The flue K (figs. 10, 11 and 12) is in connection with chambers B, whose upper part is filled up with parallel rows of shutter-like plates turning round a central pivot. Iron bars *c* and levers *e* are fastened in a manner, that one guide-road *d* is sufficient to work two sets of shutters.

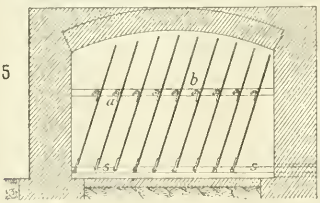
Fig 14.



The gases of the process try to pass between the spaces and since they find many obstacles in their way they have to unroll themselves, as it were, depositing any solid matter which they carry with them. The increased surface, thus offered and the oblique position of the shutters is also favourable for condensation. As soon as the plates are filled up with dust a to and fro movement of the rods *d* causes the solid matter to scale off and fall down to the bottom.

The Ems Lead and Silver Works (Ger. Pat. 26006, 1883,) places baffle-plates in flues in order to catch any solid matter mechanically carried away by gases. These plates have an oblique position and this is attained by fastening them to a bar *b* outside their centre of gravity (fig. 13), or by suspending them from the top with hooks

Fig 15



of a special shape (fig. 14), or better still by fastening them to a bar *b* and allowing them to rest on a rod *s* provided with barb-bolts (fig. 15). If the rod *s* has a handle outside the flue, the latter arrangement allows of altering the position of the plates at will, which will be found very convenient for cleaning.

Notes on the Siemens-Martin Steel Process. Dingl. Polyt. Journ. 253 (12 and 13) p. 509-514.

M. JUNGCK has published an investigation on the practical details of the Siemens-Martin process as carried out at the "Phenix" works of Ruhrort. The gas-producer consists of eight chambers, which are charged every three hours with 600kg. coal of the following composition :—

C	71·10
H	4·21
O & N	11·92
Ash	12·74

The gas of two chambers suffices for one furnace, each of which is provided with four regenerative chambers. The author reports on two operations, a normal and an irregular one. In the first instance the furnace was charged at 3 a.m. with :—

300kg. Bessemer pig-iron.
100 Maryport, and
150 Spiegel.

After 45 minutes the mass was in a fused state, and about every 45 minutes the following additions were made :—

2 charges	each of	350kg.	Bessemer rail ends.
1	,,	300	Bessemer steel.
5	,,	300	Bessemer rail ends.
1	,,	300	Bessemer steel.
2	,,	250	Bessemer rail ends.

At 11.40 a.m. 115 kg. Spiegel were added, when the steel possessed the hardness required (just 5 of the Styrian scale) and was tapped. Previous to every addition a sample was drawn and examined for the nature of the fracture. The first sample was fibrous on the edge, fine-grained, and light-grey in the inside, and of a smooth surface. After the first addition of Bessemer rail, the fracture was less fibrous and quite white, the graphite having been converted into chemically-combined carbon. Gradually the fibrous structure disappeared altogether, and the grain of the fracture slowly passed from fine-grained pig-iron to fine-grained steel. After the 7th charge, the sample had the appearance of a good fine-grained, but rather hard steel. One would feel inclined to interrupt the process at that stage, to save the addition of ferro-manganese or Spiegel at the end, but this would not be economical, since the quantity of steel ends worked up is larger by one-third for an equal amount of pig-iron and Spiegel. Besides, the result would be too uncertain. From the 8th charge the formation of ingot-iron sets in. The fracture becomes coarse-grained, and the sample is completely permeated by blisters of a longish shape. But when the steel is finished, its surface is again smooth and little blistered, showing that all gas-bubbles have escaped. The product had all the physical proportions of a good Martin-steel, and tested on analysing :—

Mn	0·301%
C	0·336
Si	0·035
P	0·160
S	0·006
Fe (with a trace of Cu)	99·159

The small percentage of silicum is remarkable, and indeed distinguishes Martin-steel from all other kinds. Whereas there was 17·7kg. Si in the charge, the steel run off only contained 1·38kg. Si, showing that 12-13ths of the total silicum went into the slag. In the same manner, of 38·9kg. C, which were put into the furnace, 13·3kg. C remained in the steel while 25·6kg. C were oxidized. The slag tested as follows :—

SiO_2	50·18
P_2O_5	0·020
S	0·011
FeO	25·75
Al_2O_3	2·61
MnO	20·41
CaO	0·62
MgO	0·17
	99·804

It is also worth mentioning that on cooling, the slag rises considerably, giving off large volumes of carbonic oxide, which burns with a blue flame. The liquid slag, therefore absorbs carbonic oxide in large quantities.

In a second operation the furnace was worked too cold, although plenty of gas was burned. The batch was started at 7.0 a.m., with :—

350kg. Ruhrort grey Bessemer pig-iron,
150 Spiegel, and
100 English pig-iron.

After fusing, the following additions were made, every 35 to 40 minutes up to 2.10 p.m. :—

2 charges,	each of	350kg.	Bessemer ends.
1	,,	300	Puddle-steel ends.
1	,,	300	Bessemer & Martin steel rail.
2	,,	250	Do

At the conclusion, 125kg. Spiegel were added, but the steel being too soft, two other charges of 40kg. and 10kg. Spiegel were made, until the steel had the hardness of 5 (Styrian scale) when it was tapped at 2.40 p.m.

An average sample of the producer-gas, employed for heating during this operation, tested :—

	Per cent. by Volume.	Per cent. by Weight.
N	61·49	61·83
CO_2	4·15	7·36
CO	23·24	24·50
Hydrocarbons	2·07	1·21
H	6·49	0·55
Steam	2·26	1·52

There were also present in the gas 13·61 per cent. by weight of soot, and 0·9 per cent. tar. Since the gas only contained about 27 per cent. of combustible constituents, the decreased temperature of the furnace can be easily accounted for. The fire-gases contained 0·13 per cent. soot, whereas the tar was completely burnt. They tested :—

	Per cent. by Volume.	Per cent. by Weight.
N	68·17	65·74
CO_2	12·76	19·33
CO	1·73	1·66
H	0·78	0·05
O	6·05	6·66
Steam	10·51	6·57

In considering the different methods of steel-making, the author compares the Siemens-Martin process with a much-protracted puddling operation. The former, however, is carried out at a great deal higher temperature and with a mass, always in a fused state.—S. H.

Analysis of some old Indian Bronze and the Patina of the Same. By A. Arche and C. Hassack. Dingl. Polyt. Journ. 253, (13) p. 514 to 519.

THE specimens were taken from two old Indian kettle-drums, one of which was patched with a third bronze. The quantitative analysis was performed as follows: The alloys were dissolved in hydrochloric acid, adding gradually some nitric acid, filtering and precipitating with sulphuretted hydrogen. In the filtrate from this iron was separated by ammonium sulphide, and lime by means of ammonium oxalate. The precipitate with sulphuretted hydrogen was digested with sodium sulphide to extract tin, antimony and arsenic, which were separated according to H. Rose's method. The precipitate insoluble in sodium sulphide was dissolved in nitric acid, treated with sulphuric acid for precipitating lead and then with sulphuretted hydrogen to estimate copper as cuprous sulphide. Another portion of the alloy was oxidised with hydrochloric and red nitric acid, to determine sulphur as sulphuric acid. The insoluble residue was considered as SiO_2. An elementary analysis yielded the carbon, whereas the water found was calculated as constitutional water. In order to get at the oxygen contained in the oxides a reduction in a current of hydrogen was performed and after deducting the water found in the elementary analysis, the rest was calculated as oxygen. The following figures were thus obtained :—

	A.	B.	Stuff for patching.
Cu.	60·82	70·79	68·78
Pb.	15·68	14·25	17·55
Sn	10·88	1·90	6·88
Sb.	1·16	3·21	——
As.	trace	0·79	——
Fe.	0·91	0·30	0·85
CaO	0·38	0·12	trace
SiO_2	1·13	1·26	0·29
S	1·37	2·20	1·49
C	1·05	0·91	0·70
H_2O	2·92	0·89	1·89
O	3·13	——	0·66
	99·43	99·65	99·09

By leaving out those figures which are unimportant for the composition of bronze, the figures can be better compared with each other. The patch of the drum B was fastened with iron rivets, the iron of which tested :—

Fe	97·43
C	2·20
S and P	traces
	99·63

There was also some solder, testing thus :

Cu	66·70
Pb	3·78
Sn	0·55
Zn	23·97
Fe	0·82
SiO_2	0·12
As, S, Co, Ni	traces
H_2O, CO_2, loss	4·06
	100·00

Or if the sum of the essential components be equal to 100, there is—

Cu	69·62
Pb	3·94
Sn	0·57
Zn	25·02
Fe	0·85
	100·00

The surface of the bronze was covered with a layer of oxidised metal Patina—of beautifully green colour which was subjected to the following method of analysis. The loss of weight by drying in the desiccator was stated as moisture. The powder was then treated with dilute hydrochloric acid, evaporated to dryness, etc., to separate silica. The residue was dissolved in water and the bases separated as described above for the bronze. Carbonic acid was gravimetrically estimated and there was also made an elementary analysis of each sample. The figures were thus :—

Patina	A.	B.	Stuff for patching
Spec. grav.	3·192	2·595	——
Moisture	0·73	0·19	1·09
CuO	28·08	11·00	26·11
PbO	4·95	0·59	12·98
SnO_2	0·45	0·05	10·52
$Fe_2O_3+Al_2O_3$	2·82	1·11	4·16
CaO	1·19	0·31	5·66
MgO	trace	trace	0·27
SiO_2+Insoluble	45·29	77·51	15·24
SO_3	trace	trace	0·97
CO_2	6·33	1·60	5·14

Result of the elementary analysis :

H_2O	7·46	4·89	12·12
CO_2	14·26	6·34	19·36

From these figures, leaving out the unimportant constituents, the authors conclude the following chemical composition for the three Patinas :—

Patina A.

$CuCO_3.2CuO_2H_2$	85·83
$2PbCO_3.PbO_2H_2$	13·01
SnO_3H_2	1·16
	100·00

	Patina B.	Patina of the patch.
$CuCO_3.3CuO_2H_2$	95·11	56·08
$2PbCO_3.PbO_2H_2$	4·49	24·62
SnO_3H_2	0·40	19·30
	100·00	100·00

—S. H.

XIV.—AGRICULTURE, MANURES, Etc.

Treatment of Bones. Dingl. [252] Heft. 6.

F. A. RISSMÜLLER, (German Patent No. 26,697, Aug. 30, 1883,) dissolves the unbroken raw bones in warm sulphuric acid, skimming off the fat, which is remarkable for its purity. He uses leaden pans, and sulphuric acid of 45° B., warmed to 60° (140° F.). Into this warm sulphuric acid a certain amount of bones is placed; these dissolve in three days to a clear solution, the fat swimming on the top. The fat, when skimmed off, is washed free from sulphuric acid by warm water. The remaining solution is mixed with calcium phosphates, producing superphosphate, with soluble phosphoric acid, and soluble nitrogen.—F. L. T.

On the Cultivation of the Sugar-Beet in England in 1884. Abstract of a Report by Prof. A. H. Church.

[This report is based on a careful inspection of the chief districts where sugar-beets have been grown during the past year for the new sugar factory of Messrs. Bolton and partners.]

The effect of last year's drought told unfavourably, as regards regularity and yield, but still the results of this first year's experience prove encouraging. If the weight of the crops has been small in some instances, yet a yield of about 12 tons per acre has been secured on a large proportion of the farms, whilst the average quantity of sugar in the roots nearly reached 13 per cent., corresponding to a production of $1\frac{1}{2}$ tons of crystallisable sugar per acre. Whilst the yield per acre in a few cases has been less than five tons, in others it has exceeded 15, or been as high as 20; and the whole 640 acres have produced a total of about 6,850 tons of roots, or over 10 tons per acre. Two conditions of successful sugar-beet growing, are, (1) *as close planting as possible*, and (2) that the roots do not average in weight more than something below $1\frac{1}{2}$lb. apiece. By observance of these rules good results, both as regards quantity and quality, are secured, other things being equal. To have *as close a plant as possible* is, indeed, termed by the author the "golden rule" for the sugar-beet grower. Small roots and many of them are best, both for the grower and the sugar maker, for the smaller the root the richer it is in sugar, the less saline matter does it extract from the land or the manure, and the easier it is to lift. Moreover, when the roots are near to each other the bulbs are not so much exposed, and the proportion of leaf to root is smaller; they are also less likely to grow *fanged and forked*. The following table shows the advantage of a close plant:—

(I.) Distance between the drills.
(II.) " " the single plants in the rows.
(III.) The number of roots per acre.
(IV.) The yield per acre, assuming each root to weigh 1lb.

(I.)	(II.)	(III.)	(IV.)
15 ins.	6 ins.	69,696	31 tons 2 cwt.
18 "	9 "	38,720	17 " 0 "
18 "	12 "	29,040	12 " 19 "
18 "	15 "	23,232	10 " 7 "
21 "	18 "	15,004	6 " 12 "

With regard to the question of *suitability of manures*, when the improved strontia process of Messrs. Bolton and partners is used, by which the sugar is directly precipitated from the beet-juice, then superphosphate of lime, nitrate of soda, and other artificial manures, suitable for sugar-beets, may be employed, for the increase thus caused of saline matter in the roots no longer interferes with the extraction of the sugar. Farmyard manure should never be applied directly to the sugar-beet crop, but to that which precedes it. Where it has been used, especially in the spring, the roots have been uneven in size, coarse in quality, and much fanged. In light soils and dry seasons farmyard manure may help to secure a tolerable yield, but at the sacrifice of almost every desirable character in the root. Another condition of importance is *cleanness of the land, i.e.*, freedom from weeds, amongst which, especially *couch grass*, which is very prejudicial. Besides "thick sowing," it is also very important that early thinning and careful singling be observed; moreover, earthing of the exposed part of the roots; cutting off any "bolted" or runaway stems; selecting the proper time for pulling the crop; drawing without wounding the roots; with many other minor details of cultivation. Despite the scepticism amongst well informed and even scientific men, as to the production in this country of a crop of sugar-beet having a high proportion of sugar, the author adduces proof of the soundness of the position assumed by the advocates of English sugar-beet growing, in the recital of experiments made on the large scale in 1884, in Surrey, Berks, Oxfordshire, Middlesex, Northamptonshire, Lincolnshire, Staffordshire, Worcestershire, Warwickshire, Suffolk, Norfolk, Cambridgeshire and Essex, and also County Wexford, Ireland, which show perfectly encouraging results, although the year cannot be regarded as a favourable one in point of weather and other natural conditions. Though it is stated that a hot dry summer is the only one suited for the sugar-beet growth, this statement cannot be taken without modification, and it becomes the reverse of the truth with a shallow and gravelly soil, and when the spring rains have not sufficed for the regular germination of the seed.

Touching *the best time for gathering*; in the Cirencester experiments of 1870 and 1871; during the former year the increase of sugar continued up to and even after the middle of October; during the latter it practically ceased a week earlier. In both years, during the first half of November, the amount of sugar remained practically stationary, but afterwards a decided diminution of the percentage became apparent. Although observations of rainfall and temperature during the latter part of the autumn serve in guiding to a judgment as to the probable saccharine ripeness of the crop, it is by far the best to take a fair sample of roots, and ascertain the exact content of sugar by determinations of the specific gravity of the juice, or by analyses with the polariscope. There are various kinds of sugar-beet, and there are several improved sorts now at disposal. It is evident—and this is a matter worthy of the consideration of all the farmers in the country—that under normal conditions, *sugar-beet must pay better than wheat does, at present prices.* However, to ensure success, and to compete successfully with Continental producers, growers in this country must bestow their best land and their best care; they must learn that practically the selling value of the crop is to be regulated by the yield of sugar per acre, and this is the correct light in which to view the subject.

As regards *hardiness in times of drought*, the sugar-beet stands better than the ordinary mangolds, which have been almost a failure last year, even on heavy lands. In many fields, in which mangolds and sugar-beets were sown side by side, the mangolds did not appear, whilst the sugar-beets yielded a fair plant. Professor Church hopes that the important field experiments of 1884 will be continued during 1885, with every precaution to ensure success.

Value of Sugar-beet as Cattle Food.—Most satisfactory have been the experiments in this direction, and chemical analysis explains the superiority of sugar-beet over other roots, for feeding purposes; whilst mangolds usually contain 90 per cent. of water, and swedes and white turnips often more, sugar-beets generally average about 81 per cent. A crop of sugar-beet, although its gross weight may not be much more than half that of other kinds of roots, will contain quite as much solid nutritive matter. It presents the further advantage of containing less of those saline matters which, without being useful in animal nutrition, tend by their removal from the soil, towards the exhaustion of the latter.—W. S.

XVI.—BREWING, WINES, SPIRITS, Etc.

A New or Improved Apparatus for Injecting and Mixing Fluid Carbonic Acid in Small Regulated Quantities with Beer and Sparkling Liquors. Loventz Albert Groth. Eng. Pat. 10,437, July 22, 1884.

The object of this invention is to inject and mix fluid carbonic acid in small regulated quantities into beer, sparkling liquors, or mineral waters, in a safe and simple manner, and consists of a receptacle A for the fluid carbonic acid, a regulator B to regulate its flow, and a mixing chamber C, fig. 1. The receptacle A, which is placed above the regulator, is provided with an outlet at the bottom, to which is connected the pipe leading to the regulator B, which is placed just above the mixing chamber *c*. The regulator B consists of a strong bulb P, with narrow neck *k*, screwed and soldered to it, forming the spigot of the tap *o*, and by the opening *r*, can allow the carbonic acid to flow in any required quantity, or stop it entirely, by turning the bulb P, like an ordinary tap. The mixing chamber *c* is an ordinary air-tight one, strengthened if need be by iron bands, and provided with a mixer *e* and manometer *m*. The action is as follows:—The carbonic acid flows by means of the outlet in the receptacle through the pipe into the entering tube *r u*, of

the tap or regulator B, and through the opening r, into the bulb P, from whence it is allowed to flow by turning the said bulb into the lower pipe q, leading into the mixing chamber c, while by turning the mixer c, the

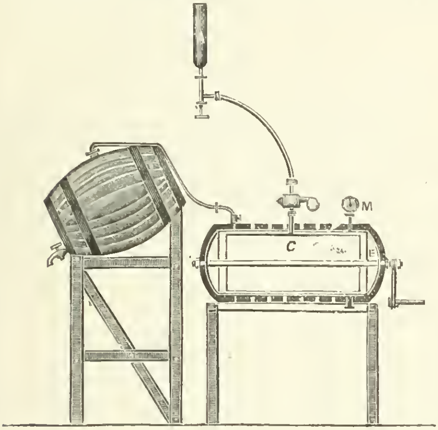


FIG. 1.

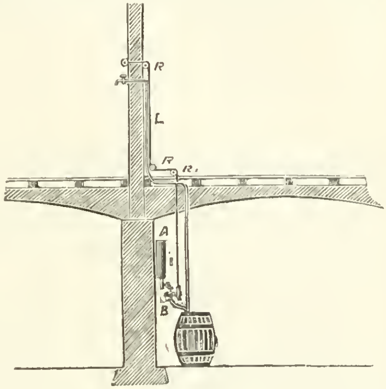


FIG. 3.

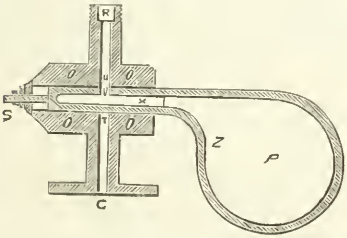


FIG. 2.

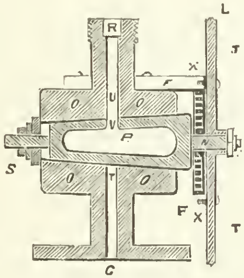


FIG. 4.

carbonic acid is mixed with the liquid contained therein. When it is required to inject fluid carbonic acid into beer casks, either for cooling or in order to press the beer up to the bar, the apparatus is simply connected to the cask as shown in fig. 3.—A. W.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

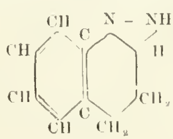
Communication of Cholera by Drinking Water. Dingl. [252] Heft. 6.

DR. ROB. KOCH, the head of the German Scientific Commission for the Investigation of Cholera, has succeeded in discovering specific bacilli in the intestines of those dying of cholera both in Egypt and in Calcutta. By artificial cultivation in gelatin the cholera bacilli may be obtained free from others, and can be recognized with certainty by their form and characteristic properties. By gelatin cultivation, cholera bacilli were obtained in all cases from the evacuations of cholera patients, or from the contents of the intestines of those dying from cholera. On examining the contents of the intestines of other corpses in the same way, the specific bacilli were found invariably absent, thus showing that the cholera bacillus is not an ordinary inhabitant of the intestines. In 1870 the mortality in Calcutta was on the average 10·1 per 1,000. Since 1870 it has fallen to three per 1,000. This diminution is attributed by the local medical men to the introduction of a supply of drinking water. Small epidemics of cholera are very frequent, confining themselves generally to the immediate neighbourhood of a so-called tank, *i.e.*, a small pond or pool surrounded by huts, and constituting the whole water supply for all purposes of the inhabitants, such as washing, bathing, and drinking. Very frequently also latrines are to be found on the very edge of the water tank, draining into it. By means of the gelatin cultivation, Koch detected the cholera bacilli in the water of such a tank, but only in the course of an epidemic, only one of many samples of water taken at the end of the epidemic yielding the bacilli. It is noteworthy that the cholera bacilli can only be kept active by being preserved from drying up. They remain capable of development in liquids for weeks, and everything appears to indicate that they can only become incorporated with the human body when they are in the moist state.—F. L. T.

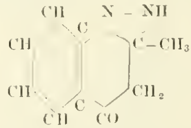
XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES.

On the Constitution of Quinizine Derivatives. Ludwig Knorr, Berl. Ber. 17, 2032.

THE author gives the name quinizine to a hypothetical base,



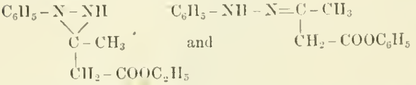
from which a number of new bodies may be derived. The first of these derivatives, methyl oxyquinizine, has already been described by the author (Berl. Ber. 17, 546), and has the constitution



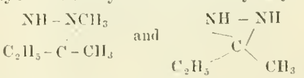
It is obtained by the condensation of equal molecules of phenylhydrazin, and aceto-acetic ether, thus:

$$C_6H_5N_2H_3 + C_6H_{10}O_3 = H_2O + C_2H_5OH + C_{10}H_{10}N_2O.$$

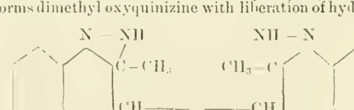
The reaction takes place in two stages; in the cold, water is eliminated and phenylhydrazine aceto-acetic ether formed, and this on heating yields alcohol and methyl oxyquinizine. Of the two formulæ



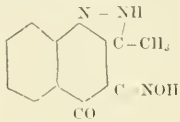
by which phenylhydrazine aceto-acetic ether may be represented, the first is correct, for the hydrogen atom united to the second nitrogen atom in the hydrazine is still present in methyl oxyquinizine, and may easily be replaced by alcohol radicals. When the tertiary dimethyl oxyquinizine is heated to 200 with hydrochloric acid it yields aniline and methylamine; but methyl aniline is not formed. When distilled with zinc dust dimethyl oxyquinizine and methyl oxyquinizine form the same relative quantity of aniline, together with benzene and easily volatile bases, probably condensation products of methyl hydrazine and hydrazine with methyl ethyl ketone,



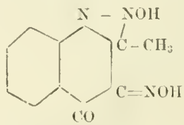
Here, again, methyl aniline was not obtained from dimethyl oxyquinizine. Lastly, the condensation products of the secondary hydrazines with aceto-acetic ether are not quinizine derivatives, but belong to another class of bodies. In the condensation of phenylhydrazine aceto-acetic ether, the ethoxy-group, no doubt, unites with a hydrogen atom of the benzene ring to form alcohol, and not with the methylene group, for the latter remains in methyl oxyquinizine, for by the action of nitrous acid on methyl oxyquinizine the same isonitrosomethyl oxyquinizine is obtained as by the direct condensation of isonitroso aceto-acetic ether, with phenylhydrazine. All the properties and reactions of methyl oxyquinizine agree with the formula given above. It is both an acid and a base, but the acid properties disappear when the hydrogen of the imido group is replaced by an alcohol radical, and the base so obtained has powerful antifebrile properties. The methylene group has no longer the power of replacing hydrogen by metals, but it reacts with nitrous acid, and forms condensation products with aldehydes and ketones. Methyloxyquinizine also resembles aceto-acetic ether in its tendency to form condensation products. Thus, when boiled with phenyl hydrazine, it forms dimethyl oxyquinizine with liberation of hydrogen.



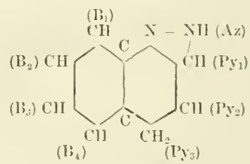
The same compound is also formed by the condensation of diaceto-succinic ether, with phenyl hydrazine. When treated with nitrous acid methyl oxyquinizine yields at first isonitrosomethyl oxyquinizine,



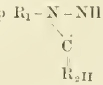
while dimethyl oxyquinizine forms a blue colouring matter, with liberation of two atoms of hydrogen, which, on reduction, is converted again into dimethyl oxyquinizine. In this reaction the nitrogen atoms of the imido groups combine to form an azo-compound, for if the hydrogen atoms of the imido groups in the diquinizines are replaced by alcohol radicals, colouring matters are not formed by nitrous acid. When the hydrogen in the methylene group of simple quinizine derivatives is replaced by alcohol radicals, such azo-compounds are also formed; isonitrosomethyl oxyquinizine, however, yields an oxidation product with nitrous acid, probably



which, like the isonitroso compound and methyl oxyquinizine, is converted by nitric acid into the diquinizine blue. In the nomenclature of the quinizine derivatives the author adopts Baeyer's recommendations, and represents the atoms in the benzene, pyridine and imido groups, by the symbols B, Py and Az respectively, thus—



while the carbizine group



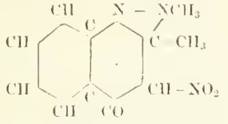
is indicated by the termination *izine*. Accordingly, the author would call phenyl hydrazine aceto-acetic ether, phenylizine aceto-acetic ether. *Methylated methyl oxyquinizine* (*Antipyrine*). The compound $C_{11}H_{12}N_2O$ (Berl. Ber. 17, 549) is undoubtedly az-methyl-Py 1, methyl 3, oxyquinizine, and is isomeric with the dimethyl oxyquinizines obtained from the tolyl-hydrazines (*loc. cit.*), and with the quinizine derivatives from methyl aceto-acetic ether. The compounds thus formed are B-1 methyl Py-1 methyl 3, oxyquinizine; B-3 methyl Py-1 methyl 3 oxyquinizine, and Py-1-2, dimethyl 3 oxyquinizine, and all of them have acid properties. The az-methyl compound is easily soluble in water, while methyl oxyquinizine is almost insoluble.

Physiological Action of Dimethyl Oxyquinizine (*Antipyrine*). This subject was investigated by Prof. Filehne (Zeitschr. für Klinische Medicin, VII., part 6). The substance is to be recommended as a febrifuge on account of its solubility and cheapness, and its powerful action, with no deleterious after effects. It is manufactured by Messrs. Meister, Lucius and Brüning, in Höchst, under the name "antipyrine." It cannot be employed for malaria. The physiological investigation of the diantipyrine obtained from dimethyl oxyquinizine is interesting, for it contains two quinoline groups, like quinine. Ferric chloride colours an aqueous solution of antipyrine

deep red, and nitrous acid produces a blue green colouration, or if concentrated, green crystals, an isonitroso compound being formed. One part in 100,000 may be recognized by the ferric chloride reaction, and 1 in 10,000 by nitrous acid. Antipyrine forms condensation products with aldehydes, and a crystalline nitroantipyrine with nitric acid.

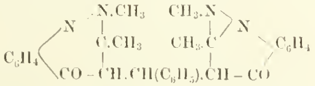
Isonitroantipyrine. $C_{11}H_{11}N_3O_2$ was obtained in green crystals by treating an acid solution of antipyrine with a solution of nitrite. It is insoluble in water and dilute acids, soluble in alkalis and acetic acid, less so in alcohol, and difficultly soluble in chloroform and ether. Excess of nitrous acid has no reaction on it. By reduction of its solution in acetic acid a colourless oil is formed, which becomes red on oxidation. Nitroantipyrine yields the same products, which are probably amido- and oxyantipyrine.

Nitroantipyrine.—Concentrated nitric acid, previously boiled, dissolves antipyrine, and on warming forms a blood-red solution, from which water precipitates white needles of nitroantipyrine, $C_{11}H_{11}N_3O_3$,



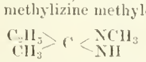
The crystals melt at 270° to 280°, and are insoluble in water and alkalis, and but slightly soluble in concentrated hydrochloric and nitric acids.

Benzylidene diantipyrine, $C_{29}H_{28}N_4O_2$, is formed by adding concentrated hydrochloric acid to a solution of antipyrine in oil of bitter almonds. The hydrochloride crystallizes from dilute hydrochloric acid in long silky needles, from which caustic soda liberates the base. It may be crystallized from alcohol or ether. Its constitution is probably—



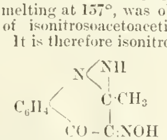
Nitrous acid has no action on it, therefore the condensation probably takes place in the methylene groups.

When antipyrine is heated with hydrochloric acid to 200° it is completely decomposed—methylamine, aniline and ammonia being formed. When distilled with zinc dust a red oil was obtained. On fractionation a portion distilled between 80 and 90°, another between 180 and 185°; but the greater part boiled above 300° with decomposition. The first portion consisted of benzene and an oil, boiling at 86° to 87°, containing 25 per cent. of nitrogen, probably methylizine methylethyl-ketone



A similar oil was obtained by distilling methyl oxyquinizine with zinc dust. The second fraction was pure aniline. The third forms a crystalline picrate, but has not yet been investigated.

Action of Nitrous Acid on Methyl Oxyquinizine. A brown oil was obtained, which sodified in yellow needles. It crystallized from acetic acid, and melted at 137°. Its composition was found to be $C_{10}H_9N_3O_2$. The same substance, melting at 137°, was obtained by direct condensation of isonitrosoacetoacetic ether with phenylhydrazine. It is therefore isonitrosomethyloxyquinizine



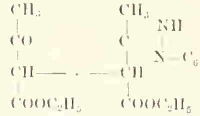
It dissolves with difficulty in water and acids, easily in hot glacial acetic acid and alcohol, and is moderately soluble in ether. It is a strong acid. It begins to sublime at 100°, and decompose above its melting point.

Through an inadvertency, the continuation of this abstract is to be found on page 63, column 1, commencing with the heading *Isonitrosomethyldioxyquinizine.*

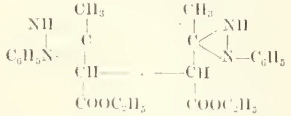
On the Action of Diacetosuccinic Ether on Phenylhydrazine. Ludwig Knorr and Carl Bülow. Berl. Ber. 17, 2057.

The following substances were obtained by the condensation of these bodies:

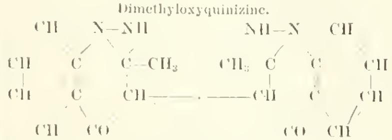
Phenylizine-acetosuccinic Ether.



Diphenylizine diacetosuccinic Ether.



Dimethyloxyquinizine.



The second compound is the most easily prepared. It is formed by mixing the alcoholic solutions, or by fusing the reacting substances on the water bath. At 180° the first and third compounds are formed, from which the first may be extracted with alcohol, leaving the third as a crystalline powder. The second compound is converted into the third by heating in toluene to 180°. The first could not be converted into the second.

Phenylizine-acetosuccinic ether. The alcoholic solution obtained as above described was treated with water, when an oil was deposited. The ethereal solution of the oil was shaken with acid, then with alkali, and the residue after evaporation dissolved in alcohol and precipitated as before. The oil solidified rapidly and was crystallized from acetic acid or petroleum spirit. The crystals melt at 91° and have the composition $C_{18}H_{24}N_2O_5$.

Diphenylizine-diacetosuccinic ether was obtained by adding a solution of 5grms. diacetosuccinic ether in alcohol to an aqueous solution of 8grms. phenylhydrazine hydrochloride and 12grms. sodium acetate. The substance was deposited on warming the mixture in fine crystals which have the composition $C_{24}H_{30}N_4O_4$. The substance was better prepared by melting the reagents together. The ether is insoluble in water, alcohol, acids, or alkalis.

Di-methyloxyquinizine was obtained as already described. It melts above the boiling point of sulphuric acid, and after drying at 120° is powerfully electric. It has the composition $C_{20}H_{18}N_4O_2$. It is identical with the substance prepared by the action of phenylhydrazine on methyl oxyquinizine. It yields diantipyrines and a diquinizine blue. The diantipyrine melts at 250 and has the composition $C_{22}H_{22}N_4O_2$. The solution of the sodium salts of both di-methyl oxyquinizines give precipitates of the same colour with the solutions of most heavy metals.—S. Y.

On the Action of Ethyl succinylosuccinate on Phenylhydrazine. Ludwig Knorr and Carl Bülow. Berl. Ber. 17, 2053.

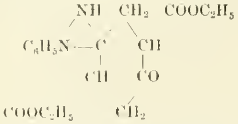
Knorr has already shown that the chief product of this action is a yellow body of the composition of $C_{20}H_{16}N_4O_2$, which is formed thus—

$$C_{12}H_{16}O_6 + 2C_6H_8N_2 = 2H_2O + 2C_2H_5OH + C_{20}H_{16}N_4O_2$$

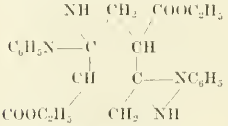
(Berl. Ber. 17, 546). It is evidently a quinizine derivative, and must be diquinizinohydrobenzene. By varying

the conditions of experiment, the following substances have now been prepared by the authors :—

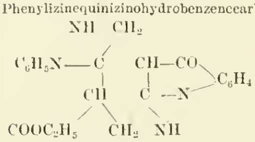
Ethyl phenylizine-succinylosuccinate.



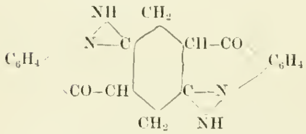
Ethyl Diphenylizine-succinylosuccinate.



Ethyl Phenylizinequinizinohydrobenzenecarbonate.



Diquinizinohydrobenzene.



The last two bodies exhibit the characteristic properties of methyloxyquinizine. The condensation products yield no colouring matters. When an excess of succinylosuccinic ether is warmed with an alcoholic solution of the phenylhydrazine reagent prepared by E. Fischer's method, a small quantity of ethyl phenylizine-succinylosuccinate is formed in addition to diquinizinohydrobenzene. After purification by precipitation of the alcoholic solution with water, the substance crystallized in needles, which melted at 159–160°, and which have the composition $C_{18}H_{22}O_5N_2$.

When two equivalents of hydrazine dissolved in toluene were heated for several hours with one equivalent of ethyl succinylosuccinate and a little acetic acid, the second compound described above was formed, together with the last two. It was separated by boiling with alkali, and formed a yellow crystalline powder, melting at 205–206°. Its composition is $C_{24}H_{28}N_4O_4$. It forms a carmine-red solution with acids. It is destroyed by boiling with strong acids, and gives no colouring matter with nitrous acid.

The ethyl diphenylizinesuccinylosuccinate was separated from the diquinizinohydrobenzene by boiling with toluene. It crystallizes from toluene in yellow needles, which melt at 211–212°, and have the composition $C_{22}H_{22}N_4O_3$. Its properties are intermediate between those of the second and fourth compounds. It is insoluble in water and alcohol; its alkaline solution is yellow; its acid solution a light rose colour. The acid solution oxidises in the air, but more quickly with nitrous acid, forming emerald green, or, if dilute, a blue solution, which on further oxidation becomes brown. The last two substances evolve a green vapour on heating.

Diquinizinohydrobenzene was best prepared by heating an alcoholic solution of the reacting substances. The product separates slowly as a yellow crystalline powder, and the reaction is complete after heating for about a day. When prepared in this manner it is free from the other substances. It forms a purple solution with alkalis and ammonia, and is reprecipitated by acids and carbonic anhydride. It dissolves in strong acids, and is precipitated again by water. It forms substitution products corresponding with the antipyrines, and gives a blue colouring matter by oxidation. When the neutral sodium salt is boiled for several hours with methyl alcohol and excess of methyl iodide, dimethyldiquinizinohydrobenzene is precipitated in yellow needles, which have the composition $C_{22}H_{26}N_4O_2$. It is easily soluble in acids, less so in chloroform and toluene, but is difficultly soluble or insoluble in most substances. The chloroform and toluene solutions exhibit a fine fluorescence resembling uranium glass. The diethyl compound was also prepared.

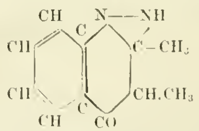
Diquinizinohydrobenzene blue was prepared by acidifying an alkaline solution of diquinizinohydrobenzene and a nitrite. It separates in blue flakes, which were extracted with chloroform, and washed with ether. It has the composition $C_{20}H_{14}N_4O_2$, and is formed thus:—

$$C_{20}H_{16}N_4O_2 + O = H_2O + C_{20}H_{14}N_4O_2.$$

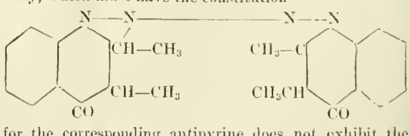
Since dimethyldiquinizinohydrobenzene is unaltered by nitrous acid, the formation of the colouring matter is analogous to that of diquinizine blue. The substance sublimes with partial decomposition, forming purple-red vapours and a blue sublimate of the unaltered colouring matter. The same sublimate is formed by heating diquinizinohydrobenzene.—S. Y.

On the Action of Substituted Acetoacetic-ethers on Phenylhydrazine. Ludwig Knorr and Albert Blank. Berl. Ber. 17, 2,049.

Methylacetoacetic ether and phenylhydrazine. Equal parts of the two substances were heated to 140°, and the product poured into ether, from which the condensation product was precipitated. It melted at 127 to 132°, and had the composition $C_{11}H_{12}N_2O$. It is isomeric with antipyrine, and is Py-1,2 dimethyl-3 oxyquinizine



Like methyloxyquinizine it is an acid and a base, and yields an antipyrine, melting at 84° when heated to 100° with methyl iodide and methyl alcohol. Excess of phenyl hydrazine does not give a diquinizine. Oxidising agents, such as nitrous acid, convert it into an indifferent body, which must have the constitution

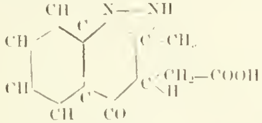


for the corresponding antipyrine does not exhibit the reaction. This body, azo-dimethyl-oxyquinizine, melts at 164°, but cannot be distilled. It crystallizes from hot glacial acetic acid and alcohol: it is insoluble in water, acids and alkalis, but dissolves in concentrated sulphuric acid. It was analysed.

Ethylacetoacetic ether and phenylhydrazine yield Py-1 methyl-2 ethyl-3 oxyquinizine, $C_{12}H_{14}N_2O$, melting at 108°. It dissolves easily in chloroform, alcohol, and benzene, less so in ether and petroleum spirit. It crystallizes from hot water in needles, containing one molecule of water which is given up at 80°. The hydrated and anhydrous substances were analysed. Azo-methyl-ethyl-oxyquinizine was prepared like the dimethyl compound. It melts at 160°, and has the composition $C_{24}H_{26}N_4O_2$.

Acetosuccinic ether and phenylhydrazine form a condensation product which melts at 80°, and has the composition $C_{16}H_{22}N_2O_4$. It is phenylizine-acetosuccinic ether. At 150° it gives up alcohol and forms methyl-

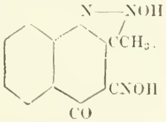
oxyquinizine acetic ethers. (Py-1 methyl-3 oxyquinizine Py-2 acetic ether). Recrystallized from petroleum spirit, it melts at 138°, and has the composition $C_{14}H_{16}N_2O_3$. By saponification with 10 per cent. sulphuric acid methyloxyquinizine acetic acid is formed. It crystallizes from water in needles, which melt at 178°, and have the composition $C_{12}H_{12}N_2O_3$. Its constitution is—



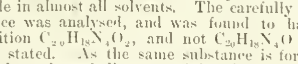
(Py-1 methyl-3 oxyquinizine-Py-2 acetic acid).—S. Y.

Isonitrosomethyldioxyquinizine, $C_{10}H_9N_3O_3$, was obtained as a black oil by acidifying an alkaline solution of methyloxyquinizine and sodium nitrite. It was extracted with ether, and crystallized from alcohol in colourless prisms. It is Az-oxy-Py-1 methyl 2 isonitroso-3 oxyquinizine :

It is insoluble in acids, but dissolves in alkalis. With nitric acid it yields diquinizine blue. When methyloxyquinizine is warmed with previously boiled concentrated nitric acid an oil is deposited, but is destroyed by further oxidation. Water was therefore immediately added, and the substance extracted with ether. The solution, however, rapidly became blue owing to the formation of a substance having the properties of diquinizine blue. The colourless product was not obtained pure, but it yields isonitrosomethyldioxyquinizine with nitrous acid, and it is therefore probably methyldioxyquinizine :



Action of Phenylhydrazine on Methyloxyquinizine. When a solution of methyloxyquinizine in phenylhydrazine is boiled, rhombric crystals are deposited, which are insoluble in almost all solvents. The carefully purified substance was analysed, and was found to have the composition $C_{20}H_{18}N_4O_2$, and not $C_{20}H_{18}N_4O$ as previously stated. As the same substance is formed by the condensation of diacetosuccinic ether with phenylhydrazine its constitution must be—

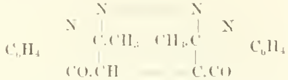


and it is di-methyloxyquinizine. In this reaction the hydrazine acts as an oxidising agent, removing hydrogen from the methyloxyquinine, and forming aniline and ammonia thus :

$$2C_{10}H_{10}N_4O_2 + C_6H_5NH.NH_2 = C_{20}H_{18}N_4O_2 + C_6H_5NH_2 + NH_3.$$

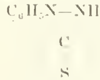
Almost the theoretical yield of di-methyloxyquinizine is also obtained by heating two molecules of acetoacetic ether with three molecules of phenylhydrazine. The reaction appears to be a general one for all quinizine derivatives in which the methylene group is unaltered; thus β-naphthylmethyloxyquinizine gives a di-β-naphthylmethyloxyquinizine. By heating di-methyloxyquinizine with methyl iodide and methyl alcohol, di-antipyrine is formed. It melts at 250°, and has the composition $C_{22}H_{22}N_4O_2$. The corresponding ethyl compound melts between 240° and 250°. The same compound may be prepared by boiling the alcoholic iodides with a solution of di-methyloxyquinizine in sodium ethylate. They are difficultly soluble in water, and their salts crystallize well.

Diquinizine Blue. When di-methyloxyquinizine is treated with nitrous or nitric acid a blue substance, having the composition $C_{20}H_{16}N_4O_2$ is obtained, thus $C_{20}H_{18}N_4O_2 + O = H_2O + C_{20}H_{16}N_4O_2$. The reaction takes place in the imido groups, for the anti pyrines do not give similar bodies, and the constitution of diquinizine blue must be—



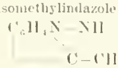
It is insoluble in water and dilute acids and alkalis, and difficultly soluble in alcohol and ether, but dissolves easily in chloroform and concentrated sulphuric acid, forming indigo-blue coloured solutions, the spectra of which resemble that of indigo. It has no affinity for fibres. By reduction it forms di-methyloxyquinizine. It may be prepared from methyloxyquinizine, isonitrosomethyloxyquinizine or isonitrosomethyldioxyquinizine by the action of nitrous acid. The authors show the following analogies between the quinizine derivative and other classes of substances. Their relation to phenylsulphocarbizine (Annalen 212, 332), and to the indazolle compounds (Annalen 221, 261) is shown by the carbizine group contained in the quinizine compounds. Thus :

Phenylsulphocarbizine



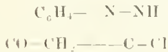
M.P. 129°.

Isomethylindazole



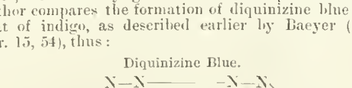
M.P. 113°.

Methl oxyquinizine.



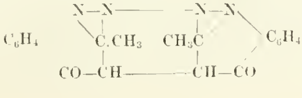
M.P. 127°.

The properties of these compounds are similar in many respects. Isomethylindazole is formed by the condensation of orthoamidoacetophenone with hydrazines. The quinoline group in methyloxyquinizine may be considered as a derivative of tetrahydroquinoline. This view is supported by the physiological action of the compounds, and the synthesis of γ-oxyquinaldine from aniline and acetoacetic ether (Berl. Ber. 17, 530). The want of similarity in the chemical properties of methyloxyquinizine and tetrahydroquinoline is explained by the fact that in the former compound the methylene group remains intact. The analogy between methyloxyquinizine and pseudooxindol is shown by their constitution—

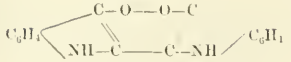


Both substances contain acid imido groups. They form isonitroso compounds with nitrous acid and condensation products with aldehydes. In both the carbon of the methylene group tends to condense to form double molecules, which easily give blue coloured products. The author compares the formation of diquinizine blue with that of indigo, as described earlier by Baeyer (Berl. Ber. 15, 54), thus :

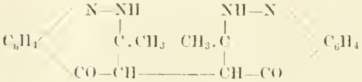
Diquinizine Blue.



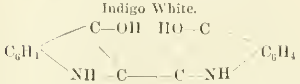
Indigo Blue.



Diquinizine.



Indigo White.



The properties of isonitrosomethyloxyquinizime and isonitrosoantipyrine also bear great resemblance to those of β-naphthoquinonoxime :

$$C_{10}H_6O(NOH)''.$$

—S. Y.

On the Cinchona Alkaloids. W. J. Comstock and Wilhelm Königs. Berl. Ber. 17, 1984.

When cinchonine is treated with phosphorus pentachloride and phosphorus oxychloride, cinchonine chloride, $C_{19}H_{21}N_2Cl$ is formed (Berl. Ber. 13,285), and on boiling this substance with alcoholic potash cinchene, $C_{19}H_{20}N_2$, is obtained (Berl. Ber. 14, 1852). Cinchene when heated to 220° to 230° with concentrated hydrochloric acid yields methyl chloride, ammonia and apocinchene $C_{18}H_{17}NO$. The authors, continuing the work, have experimented similarly on quinine and cinchonidine. A base was obtained from cinchonidine which appeared to be identical with cinchene, while quinine yielded a similar base which contained the elements of one molecule of water less than cinchene.

Cinchonine chloride was obtained by heating 30grm. dry cinchonine hydrochloride with 40grm. phosphorus pentachloride and 200grm. phosphorus oxychloride to 50° to 60° until a drop, treated with ammonia remained clear when shaken with ether. After decomposing the phosphorus compounds the cooled mixture was treated with excess of ammonia, when, after standing, cinchonine chloride was deposited as a crystalline white mass. It was dried, extracted with warm ether and filtered after cooling. The yield was about 75 per cent. The residue after evaporating the ether was boiled for about 24 hours with an equal weight of caustic potash and four or five times the quantity of alcohol. The alcohol was evaporated, the residue treated with water and extracted with ether. The substance was purified by boiling with tartaric acid and animal charcoal, and decomposing the crystalline tartrate with soda. The yield was about 50 per cent. of the cinchonine hydrochloride. The base after crystallization from petroleum ether melted at 123° to 125°. It was analysed.

When heated with hydrochloric acid of sp. gr. 1·19 for eight hours, cinchene yielded apocinchene as a yellow difficultly soluble hydrochloride, which after purification was treated with ammonia. The pure base crystallizes from alcohol in colourless needles melting at 209°. The composition $C_{18}H_{17}NO$ was proved by analysis. Oxyapocinchene was prepared from apocinchene by treatment with fused potash. The pure substance, melting at 267° was analysed, and its composition found to be $C_{18}H_{17}NO_2$.

Cinchonidine Chloride, $C_{19}H_{21}N_2OCl$.—The hydrochloride was treated like cinchonine hydrochloride, and the crude cinchonidine chloride dissolved in ether, dried with potash, filtered, and treated with ligroïn until the solution became turbid. The substance crystallized on standing, and after purification melted at 108° to 109°. The composition was proved by analysis. When treated with alcoholic potash the cinchonidine chloride yielded a base, cinchonidene, $C_{19}H_{20}N_2$. It was purified in the same manner as cinchene, which it closely resembled, except that its melting point was lower, 116° to 118°. The crystalline form of both compounds was found by Dr. Grünling to be identical. When boiled with hydrochloric acid cinchonidine yielded apocinchene, melting at 209°. Cinchonidine and cinchene thus appear to be identical, and the isomerism of cinchonidine and cinchonine probably depends on the different arrangement of the elements of the molecule of water added to cinchene to form these compounds.

Quinine Chloride $C_{20}H_{23}N_2OCl$.—This substance was prepared like the preceding chlorides, but chloroform was employed in place of phosphorus oxychloride. After purification by solution in benzene, and precipitation with ether, the chloride melted at 151°. It was analysed. The solution in dilute sulphuric acid exhibits no fluorescence, and the colour reaction with chlorine water and ammonia is not so intense as with quinine.

Quinene, $C_{20}H_{22}N_2O$, was prepared from quinine chloride by boiling with alcoholic potash. It was purified by conversion into the double chloride of zinc and quinene, which could be crystallized. The base was set free by addition of caustic soda, dissolved in ether and allowed to crystallize. It melted at 81° to 82°, and contained two molecules of water of crystallization, which were removed at 100°. Both the hydrate and the anhydrous base were analysed. The sulphate is easily soluble and is fluorescent.

Oxidation Products of Cinchene, Cinchonine and Quinine. When cinchonine is oxidised with chromic acid and dilute sulphuric acid, carbon dioxide, formic acid and cinchonic acid are formed, while quinine yields quinic acid. The constitution of these acids is well understood, but that of the simultaneously formed bye-products is unknown, and its discovery might be expected to throw some light on the groups containing the second nitrogen atom in cinchonine and quinine.

Very little success has attended the attempts to obtain well characterized products from the mother liquors from cinchonic and quinic acids. Weidel and Hazura (Wiener Monatshefte, 1882, 770) prepared from the mother liquor from cinchonic acid very small quantities of nitrooxyquinoline, Bethylpyridine, quinoline and pyridine. Neither these results nor those of Wischnegradsky and Von Oechsner de Coninck on the action of fused potash throw much light on the question.

The authors oxidised cinchene with chromic acid and dilute sulphuric acid, when carbon dioxide was evolved and cinchonic acid formed. After removal of the chromium with barium hydrate and carbon dioxide, the copper salt of cinchonic acid was prepared and removed by filtration. The filtrate still contained a large quantity or organic matter, from which no definite product could be obtained in the ordinary way. It was therefore treated after removal of the excess of copper, with bromine water until a yellow flocculent precipitate ceased to be formed.

When boiled with sulphurous acid this precipitate became nearly white, while that obtained by brominating cinchonic acid dissolves in aqueous sulphurous acid. The decolourised precipitate was insoluble in water and dilute acids, but dissolved easily in caustic soda. It crystallized well from alcohol or glacial acetic acid. The yield of the crude product was 5 per cent. The same substance was obtained from the mother liquor from cinchonic acid. After drying at 150° the substance was found by analysis to have the same composition as tribromoxylepidine $C_{10}H_6Br_3ON$. It does not melt at 280°, and may be sublimed in small quantities. When boiled with sodium amalgam and water small quantities of quinoline and hydroquinoline are formed, and it yields a very little of the former compound when heated with a solution of hydriodic acid in glacial acetic acid. The behaviour of the compound points to its being a tribromoxylepidine with the acid hydroxyl radical in the benzene or pyridine group. Lepidine as well as quinoline is formed when cinchonine is fused with alkali, and cinchonic acid may be considered as a derivative of lepidine, for it is obtained by the oxidation of the base. Hence tribromoxylepidine and cinchonic acid are probably formed from the same groups in cinchonine.

An easily soluble bromine derivative was also obtained from the mother liquor from cinchonic acid. When the strongly acid filtrate from the tribromoxylepidine was evaporated brown crystals were deposited. They were obtained after purification in colourless prisms, which, after drying at 120° to 130°, were found to have the composition $C_9H_{13}Br_2NO+\frac{1}{2}H_2O$. On treating the warm aqueous solution with nitric acid and silver nitrate half the bromine was precipitated. On boiling for some time the second atom of bromine was also removed. After removal of one atom of bromine the substance was treated with gold chloride and the gold salt analysed. It had the composition $C_9H_{12}Br NO,HCl,AuCl_3+H_2O$. The dibromo-compound melts at about 250° but blackens and evolves gas. The aqueous solution is acid and remains so after boiling with ammonia. Neither ammonia, potash, nor sodium acetate or carbonate produces precipitates. Both phosphomolybdic acid and a solution of mercuric chloride in potassium iodide give precipitates. The substance appears to have the character of a quaternary ammonium salt, which would not be decomposed by dilute alkali. Moist silver oxide appears to form the hydroxide. This would justify the view that cinchonine contains a hydrated pyridine or quinoline group, with a methyl radical combined with the nitrogen. The mother liquor from quinic acid, when treated with bromine water, gave a yellow precipitate which, however, dissolved easily in sulphurous acid, and was therefore not tribromoxylepidine. The filtrate from the yellow precipitate, after evaporation, yielded crystals identical with the second bromine derivative described above, and the yield was about the same. This derivative therefore appears to contain the second nitrogen atom of cinchonine and quinine. Cinchonine $C_{19}H_{22}N_2O$, and quinine accordingly on oxidation yield cinchonic acid and quinic acid with 10 and 11 atoms respectively of carbon, and a second product with 9 atoms of carbon, which when treated with bromine water forms the body $C_9H_{13}Br_2NO$.

Dibromocinchonine.—This substance has been prepared by Laurent (Annalen, 72, 305) and Kopp (Jahresb. 1876, 822) by boiling cinchonine hydrochloride with bromine. The authors prepared it by treating a cooled solution of 20grms. cinchonine in 320grms. chloroform and 160grms. alcohol with 21grms. bromine dissolved in 80grms. chloroform. The substance was crystallized from a mixture of carbon bisulphide and alcohol, and was then analysed. Its composition is $C_{19}H_{20}Br_2N_2O+H_2O$. The crystals when warmed appeared to give up hydrobromic acid slowly. When oxidised with chromic acid and dilute sulphuric acid, cinchonic acid, and hydrobromic acid were formed. On boiling the substance with alcoholic potash a base free from bromine was obtained in the form of colourless needles, melting at 202° to 203°. It appeared to be a dehydrocinchonine $C_{19}H_{20}N_2O$. Dibromocinchonine was prepared from pure cinchonine, but could not be obtained from cinchotine.—S. Y.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

A Double-Action Gas Wash-Bottle. Dr. F. Allihn. Dingl. Polyt. Jour. 254, 118.

This apparatus consists of an inner cylindrical washing-flask, fused on to the longer tube of an outer wash-bottle. Both the longer and the shorter tubes of the latter are fused to its hollow stopper. In the upper half of the smaller washing vessel is a ring of perforations, shown in the figure annexed. To use the apparatus, the bottle is about three-quarters filled with the washing fluid, and then gently inclined, so that the liquid can enter and fill the inner vessel, up to the ring of perforations. The long tube, which reaches nearly to the bottom of the cylindrical flask is open at its lower end, but it has, a few millimetres above, two rows of very small openings, through which the gas, broken up into minute bubbles, enters the inner vessel. After passing through the washing fluid therein contained, it finds its way through the perforations already mentioned into the liquid in the outer washing vessel. The gas here ascends in a second stream of

minute bubbles, so being washed a second time. Very perfect washing is thus attained, and the apparatus is especially useful where a rapid stream of gas is required. —E. G. C.

New Books.

Chemisch-Technische Analyse. Handbuch der analytischen Untersuchungen Zur Beaufsichtigung des chemischen Grossbetriebes. Unter Mitwirkung von L. Aubry, W. Avenarius, C. Deite, M. Delbrück, L. Drehschmidt, C. Engler, R. Gnehm, C. Heinzerling, A. Hilger, A. Jena, A. Ledebur, C. Lintner, S. Marasse, W. Michaelis, F. Muck, M. Müller, J. Philipp, C. Rudolph, H. Schwarz, P. Wagner, A. Weinhold, H. Zwick; herausgegeben von Dr. Julius Post, Professor an der Universität zu Göttingen. Mit 184 in den Text eingedruckten Holzstichen. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn; 1882.

This excellent work, well known in Germany, is the result of the compilation of details connected with various branches of the chemical industries, written and furnished by the above named eminent authorities, each an expert in his several branch, and each representing a special branch in the present work. This is an 8vo. volume, bound in the usual yellow paper cover characteristic of Messrs. Vieweg's publications, and containing 1,068 pages of subject-matter, a copious alphabetical index, 184 wood-cuts and a complete table of contents, from a list of the headings of which a fair idea of the nature of the matter treated of in the book may be gathered. These headings with their corresponding numbers, also indicate the chapters devoted to the subjects mentioned: I., Wasser; II., Untersuchung der Brennstoffe auf ihre Bestandtheile; III., Ermittelung des Heizwerthes der Brennstoffe; IV., Pyrometrie; V., Leuchtgas; VI., Die festen und flüssigen Kohlenwasserstoffe des Mineralreichs; VII., Die Metalle; VIII., Anorganische Säuren, Alkalisalze und Chlorkalk. (Rohstoffe und Erzeugnisse des Leblanc-Processes, der Salpeter-, Potaschen-, u. s. w. -Fabrikation); IX., Handelsdünger; X., Explosiv- und Zündstoffe; XI., Kalk, Cement (und Gyps); XII., Fette; XIII., Stärke, Zucker und Gährungsgewerbe; XIV., Bier; XV., Spiritus (und Presshefe); XVI., Essig, Essigsäure, Acetate und Holzgeist; XVII., Leder und Leim; XVIII., Metallsalze; XIX., Farbstoffe und zugehörige Industrieen; XX., Thonwaaren; XXI., Glas. The attention of dyers and colourists may be invited to the tests for the coal-tar colours given in chapter XIX., both alone and on the fibre. The price of the work is 26s., (26 Mark).

The Art of Leather Manufacture, being a practical Handbook in which the operations of Tanning, Currying, and Leather dressing are fully described, the principles of Tanning explained, and many recent processes introduced, as also methods for the Estimation of Tannin and a description of the Arts of Glue boiling, Gut dressing, etc. By Alexander Watt, Author of "The Art of Soap-making," "Electro Metallurgy," etc., etc. London: Crosby, Lockwood and Co., 7, Stationers' Hall Court, Ludgate Hill; 1885. [All rights reserved.]

This is an 8vo. volume, bound in cloth, and containing 412 pages of subject-matter, the introduction included. Seventy-six wood-engravings are interspersed in the text and the work concludes with some tables of decimal weights and measures, a list of works for reference and a full alphabetical index. From the table of contents, indicating the manner of subdivision of the text into chapters, the following headings have been abstracted and these indicate more essentially the nature of the matter treated of: Chapter I., chemical theory of the tanning process; II., the skin; III., hides and skins; IV., tannin or tannic acid; V., gallic acid; VI., gallic fermentation; VII., tanning materials; VIII., estimation of tannin; IX., preliminary operations; X., depilation or unhairing skins and hides; XI., raising or swelling; XII., tanning butts for sole leather; XIII. and XIV., tanning processes; XV., tanning by pressure; XVI., quick tanning; XVII., manufacture of harness and upper leather; XVIII., American tanning; XIX., hemlock tanning; XX., tanning by electricity; XXI., chemical tanning; XXII., miscellaneous processes; XXIII., cost of tanning; XXIV., manufacture of light leathers; XXV., dyeing leather; XXVI., manufacture of white leather; XXVII. and XXVIII., currying; XXIX., machinery employed in leather manufacture; XXX., embossing leather; XXXI., fellmongering; XXXII., parchment, vellum and shagreen; XXXIII., gut dressing; XXXIV., glue boiling; XXXV., utilisation of tanners' waste.

Monthly Patent List.

ENGLISH APPLICATIONS.

1884.

16651 F. W. Gerhard, Wolverhampton, and J. Smith, Stoke-upon-Trent. Depositing magnesium and its alloys. December 19

16652 F. W. Gerhard, Wolverhampton, and J. Smith, Stoke-upon-Trent. Depositing calcium and its alloys. December 19

16653 F. W. Gerhard, Wolverhampton, and J. Smith, Stoke-upon-Trent. Depositing aluminium and its alloys. December 19

16657 W. J. Cooper, Burton-on-Trent. Improvements in apparatus to be employed for excluding air from casks or other vessels when empty, which have contained alcoholic or other liquids, for the purpose of preserving them from the injurious effects of exposure. December 19

16660 The Honourable F. A. Wellesley, London. Improvements in and relating to the preservation of mare's milk. Communicated by G. L. Carrick, St. Petersburg. December 19

16663 W. Mather, Manchester. Improvements in the apparatus to be used in bleaching fabrics and yarns. December 19

16671 E. S. and S. Thompson, London. Improvements in covers and dishes for close annealing iron, steel, and other metals. December 19

16700 M. Bauer, London. Improvements in the manufacture of meat powder. Complete specification. December 19

16701 M. Bauer, London. Improvements in the manufacture of preserved meat and vegetables. Complete specification. December 19

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1885.

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Authors of papers printed in the Journal are hereby notified of the fact that, in accordance with Bye-law 43, they are entitled to receive not more than 50 gratuitous copies of their papers. Authors should state on their manuscripts their desire to have free copies, adding the number wished for. Unless the contrary be specially desired, this being stated on the manuscript, the reprints of an author's paper will not include the report of any discussion that may have arisen after the reading of the paper.

Members are hereby advised that the Subscription for 1885 falls due at the beginning of the year, and should be paid as soon afterwards as possible. The Council has decided that after January 1st, 1885, the 29th Bye-law will be strictly enforced, so that Members whose subscriptions are more than four months in arrear, will not continue to receive the Society's Journal.

Inquiries having been made as to the transactions of the Newcastle Chemical Society, the Committee of the Newcastle Section have to state that a very few complete sets are remaining, and will be sold to members at £2 10s. per set. A number of separate volumes can also be had by members wishing to complete their sets, at 10s. per volume (generally three years' issue). Application for these should be made to the Local Secretary of the Newcastle Section.

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Hy. Ashwell, Woodthorpe Grange, Sherwood, Nottingham, bleacher, etc.
J. H. Ashwell, Woodthorpe Grange, Sherwood, Nottingham, bleacher and dyer.
Capt. J. E. Bowly, R.N., Elm House, Trinity Road, Birchfield, Birmingham, brewer.
Wm. Bramley, 18, Clarence Street, Middlesbro'-on-Tees, chemist.
Alex. Buchan, 13, Willowbank Crescent, Glasgow, technical chemist.
W. H. Carey, Forest Works, Bulwell, near Nottingham, lace bleacher.
Arthur Clarke, St. Ann's Hill Factory, Nottingham, bleacher and dyer.
Jos. B. Coleman, University College, Nottingham, demonstrator of chemistry.
Claude H. Cooper, The Towers, Old Sneinton, Nottingham, hosiery manufacturer.
S. Corner, B.A., 95, Forest Road West, Nottingham, schoolmaster.
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R. M. Cuthbert, 27a, Ashley Place, London, S.W., Russia broker.
Geo. D. Davis, 249½, High Holborn, London, W.C., bleacher.
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Edmund Dowling, 83, Cable Street, London, E., oil merchant.
Chas. A. Drake, Three Mills Distillery, Bromley by Bow, E., brewer.
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S. E. Field, The Brewery, Nottingham, brewer.
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James Gow, High School, Nottingham, Fellow of Trinity College, Cambridge.
J. Albert Hall, 9, Mary Street, Harpurhey, Manchester, science student.
Oswald Hamilton, Owens College, Manchester, chemist.
S. V. Holgate, 29, Long Row, Nottingham, pharmacist.
W. Freeman Horn, Grove Works, Lombard Road, Battersea, S.W., white lead manufacturer.
F. C. Humphreys, Gas Works, Ilkeston, Nottingham, gas engineer.
S. D. Leah, 55a, London Road, Nottingham supervisor, Inland Revenue.
Oliver M. Lilly, The Croft, Spondon, Derby, colour manufacturer.
H. Martin, Poole, near Wellington, Somerset, manager, manure works.
Thomas McCall, Tar and Liquor Works, Beeton, E., chemist.
Daniel Mescal, The Patent Office, Chancery Lane, W.C., examiner.
R. T. Moore, 131, St. Vincent Street, Glasgow, civil and mining engineer.
Thos. Morgans, The Guildhall, Bristol, civil and mining engineer.
S. J. Pentecost, Regent Street, New Basford, Nottingham, lace dresser.
F. T. Purser, 82, James Street, Dublin, brewer.
T. N. Ritson, 95, St. Saviours Road, Jersey, gas engineer.
W. Shackel, Three Mills Distillery, Bromley by Bow, E., brewer.
A. H. Simpson, University College, Nottingham, demonstrator of physics.
Arnold Spiller, 2, St. Mary's Road, Canonbury, N., chemist.
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C. J. Whittaker, 75, Plantation Street, Accrington, chemical engineer.
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H. B. Fulton (l/o Quebrada Copper Co.), Kirkintilloch, near Glasgow.
L. Goldenberg (l/o London), Edison Machine Works, 107, Goerck Street, New York, U.S.A.
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G. G. Henderson, address all communications to Chemical Laboratory, University of Glasgow.
Jas. Higgin (l/o Kersal), The Hollies, Timperley, Cheshire.
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A. S. Lodge (l/o Prestwich), c/o J. H. Gartside & Co., Ltd., Malaunay, Rouen, France.
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E. V. Miller (l/o Liverpool), c/o The New Zealand Sugar Co., Auckland, New Zealand.
J. Napier (l/o Bramford), 1, St. Matthew's Place, Norwich Road, Ipswich.
Ralph W. Robinson (l/o Widnes), The Great Hall Studio, Tunbridge Wells.
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MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

March 2.—(1.) Mr. W. J. Kemp—"Some Experiments upon that part of Mr. F. B. Rawes's Patent for the 'Recovery of Sulphur,' etc., which depends upon the Action of Carbon Dioxide upon Soda Waste Suspended in a Liquid."
(2.) Mr. W. J. Williamson "The Treatment of Certain Phosphatic Minerals."
(3.) "The Stassfurt Salt Industry, and its bearing on other Industries," by C. Napier Hake and Charles Mook.
April 13.—(Monday *after* Easter)—Mr. W. J. Dibdin—"Further Notes on the 'Radial' Photometer, and the Proposed Standards of Light."
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held February 2, 1885.

THE RUSSIAN PETROLEUM INDUSTRY.

BY BOVERTON REDWOOD, F.I.C., F.C.S.

SHORTLY after my return from a visit to Baku and the principal distributing centres of the petroleum trade in Russia, last autumn, it was suggested to me that some account of the Caucasian petroleum trade would be of interest to the members of the Society of Chemical Industry. Much has been already published on the subject; but it appeared to me, upon consideration, that the whole ground had not been covered, and that the members of this society might justifiably be addressed on the technical and commercial aspects of the question.

I propose to divide my remarks under three heads—viz., (I.) Production (as the obtaining of the crude petroleum is termed), (II.) Refining, and (III.) Distribution. Under the second head I shall deal with the properties and uses of the various products, and shall bring the third section to a conclusion with a very few words in reference to the routes to Baku, in the hope that some of those present to-night may be induced to make the trip. The majority of the statistics I shall give are from notes taken during my journey; but some are quoted from the valuable official reports of Mr. Peacock, H. M. Vice-Consul at Batoum, and

from Mr. Charles Marvin's publications. I am indebted to Mr. Ludwig Nobel, as well as to Mr. Crusell, Mr. Ryden and many other officials of the Nobel Company, particularly Dr. Lagerwall, the courteous Secretary of the Company, for replies to many questions, and for affording me special opportunities of making myself acquainted with the industry. I have also to thank Mr. Burkhardt of Batoum, Mr. D. N. Sacker, agent in London for Mr. S. E. Palaschkowsky and the Batoum Naphtha Industry and Commerce Company, and Mr. E. G. von Glehn, representative of the Ragosine Company, for much valuable information.

I.—Production.

Anyone whose experience of oil-producing territory has been gained in the United States, cannot fail to be impressed, on first visiting the neighbourhood of Baku, with the very limited extent of the area within which, practically the whole of the crude oil is being collected. The oil-field from which the Baku refiners are supplied, is not in fact more than 3½ miles square; and on this small tract of land there are flowing wells or fountains which apparently could supply the whole world with lamp oil and lubricating oil. It must not, however, be assumed that the oil-bearing lands of Russia are of small area. On the contrary, it has been estimated that petroleum deposits underlie no less than 14,000 square miles, and admitting that this estimate is not based upon very reliable data, there is, I believe, no reason to doubt that something like 1000 or 1200 square miles of the Apsheron peninsula may be fairly regarded as more or less productive oil territory. No systematised attempts have yet been made to explore this large field, and strictly define its limits, for the reason that more than sufficient oil is obtained within the narrow limits I have referred to. The locality of the existing wells is termed the Balakhani or Balakhani-Saboontchi district, and it is distant about eight miles from the town of Baku, at an elevation of something less than 200 feet above sea level. A few miles away, at Surakhani, is another group of wells on the site of the prehistoric Sacred Fires; but these wells are of minor importance. Petroleum has also been obtained in quantity at Kouban, about 60 miles inland from Novorossisk, on the shores of the Black Sea; and evidence of the extension of the oil-field in a north-westerly direction has been furnished by the result of trial borings in the Crimea. In the neighbourhood of Tiflis, and in a large number of other places throughout the Apsheron peninsula, there are also petroleum pits and natural outflows of petroleum, some of which have been locally utilised. While, as I have said, the petroleum field appears to extend into the Crimea (though it is possible that there may be a succession of deposits rather than an actual belt), there is evidence of its continuous extension from Baku across the Caspian Sea to the Trans-Caspian territory. Near the Baku coast the surface of the sea is frequently covered with oil, which has floated to the surface; and in still weather the petroleum gas may be ignited. The island of Tcheleken, immediately opposite, and distant about 200 miles, contains apparently immense deposits of ozokerit. I hoped to have been able to visit this interesting place, but the Russian Government has, for political reasons, prohibited Englishmen from landing there; and in Russia the rigid passport-registration system makes every movement of the traveller known to the authorities. On the mainland, in the Trans-Caspian territory, there is stated to be abundance of petroleum; but except to supply fuel for the railway this source is not utilised.

The existence of the petroleum deposits of Baku has probably been known for 2500 years, for it is believed that the Persian fire-worshippers frequented Surakhani from the time of Zoroaster, who lived not later than 600 B.C. Gibbon states that in A.D. 624, the Emperor Heraclius wintered at the mouth of the river Kura, 70 miles south of Baku, and that his "soldiers extinguished the fire and destroyed the temples of the magi." Marco Polo, who wrote in the thirteenth century, is supposed to have referred to the petroleum of Baku when he stated that there was in this neighbourhood an abundant spring of oil not good for food, but good to burn, or to anoint camels that had the mange; and he added that people came from great distances to fetch it. In Jonas Hanway's time (the middle of the eighteenth century), Indians were worshipping at the Surakhani temple, as many as 50 pilgrims congregating there at one time. Hanway described the eternal fire as a flame in colour and gentleness not unlike a lamp that burns with spirit, only more pure, and sometimes rising to a height of eight feet, when the wind blows. I have on the table a photograph of this temple as I recently saw it. In the centre of a walled quadrangle stands a solidly built pillared and roofed rostrum of white stone, surmounted by a small trident. Around the boundary walls, with entrances from the quadrangle, are stone cells, which bear evidence of having been used as dwellings. Within these cells, and in the courtyard, there are many fissures in the ground, and upon applying a lighted match to some of these, I had no difficulty in igniting the gas, which burned with a flame of so little luminosity that in the bright daylight it was difficult to trace its outline. In some places channels of stone had been constructed to convey the gas. At the time of my visit there were neither officiating priests nor devotees, but a bell that had been used to summon the faithful, still remained suspended. Returning to the historical aspect of the subject, as to which I have only a very few more words to say, I may mention that Tcheleken island was referred to by Hanway, under the name of Naphtonia or Cherriken, as being peopled, when he visited it in 1743, by about 36 families, who had 24 large boats, owned several wells of naphtha, and carried on a brisk trade in selling the oil to Persians, Turcomans, etc. Colonel Yule states that the quantity of naphtha collected from the springs about Baku was, in 1819, estimated at 241,000 poods (more than one million gallons), the greater part of which went to Persia. Crude petroleum is still burned as a source of light in some parts of Russia, in earthenware lamps of primitive form, one of which I have on the table.

Very little is known concerning the geology of the Southern Russian oil-fields; and experience gained in petroleum-well boring in the United States, does not appear to be of much value in the Apsheron peninsula. Instead of the oil being found, as it is in America, in well-defined strata of sand-rock, it appears to exist in the Caucasus for the most part in separate cells or pockets. Professor Abich says the rocks can be assigned to the miocene formation, of which there are traces of two layers, above these being tertiary clays and sands; but the whole region has evidently been affected by volcanic action, and the strata have been broken up. Not far from Baku is an extinct mud volcano, from the sides of which petroleum exudes. The limestone found in the neighbourhood, much of which is so soft that it is squared for building with axes, is full of shells of molluscs; and this particular stone and petroleum seem to go together in the Caucasus. I remember, when visiting the Bradford oil-field in the United States, having a somewhat similar stone (a specimen of which is on the table) pointed out to me as a surface indication of petroleum. I do not propose to say much on the present occasion in

reference to the various theories put forward as to the origin of petroleum. It is well known that while some are disposed to consider petroleum as a product of the destructive distillation of coal, many more look upon it as derived from the remains of marine animals. In addition, we have Professor Mendelejeff's ingenious theory that petroleum results from the action of water at a high temperature, and under great pressure, upon compounds of iron, manganese and carbon; and I would refer those who are interested in the question to this distinguished chemist's essay, entitled—"L'Origine du Petrole," published in the *Revue Scientifique*, of November 3, 1877.

The peninsula of Apsheron projects in an easterly direction from the mainland of Trans-Caucasia, and upon the southern shore of the bay thus formed lies the town of Baku. The northern side of this peninsula is tolerably fertile; but the neighbourhood of Baku presents the appearance of a desert of sand and rock, here and there stained black by the exudation of petroleum, and with occasional deposits of salt glittering in the sun. The only vegetation which thrives in this district is the prickly camel-thorn; and it may be imagined that a more dreary prospect is nowhere presented to the eye. The oriental-looking Tartar villages, with solid flat-roofed stone buildings, surmounted by the characteristic domed chimneys, form inconspicuous features in the landscape, hardly distinguishable at a distance from the surrounding desert; and at intervals along the so-called roads water wells of primitive form are met with. Strings of camels, bearing skins of petroleum to Daghestan villages; tall sheep-skin-hatted Tartars riding on small donkeys, and gaudily-painted Persian "arbas," or two-wheeled carts, to which I must again refer, add to the thoroughly Eastern character of the scene.

The contrast between this silent desert and the bustle and confusion of the oil wells is most marked. Within the area of the present producing territory derricks are crowded together, a network of pipes like so many gigantic serpents covers the oil-sodden ground, miniature mountains of sand thrown up by the spouting wells abound, and all the remaining space is occupied by lakes of crude oil, as well as storage tanks for its reception before it is pumped to the refineries.

I had seen wells in America that were considered remarkable in regard to the quantity of oil yielded, and had read accounts of the productiveness of the Russian wells, but I was, I must confess, wholly unprepared for the evidence of abundant supply afforded by the flowing wells, or fountains, as they are locally termed, which have been struck in the Balakhani district. These wells are invariably capped to prevent waste and damage to neighbouring wells, as I shall presently explain. One of the fountains was opened in my presence, and immediately with a roar a mighty column of oil more than a foot in diameter shot up to a height exceeding 100 feet, and continued to flow without diminution of violence as long as the valve remained open, forming a lake of oil to leeward of the well. The derrick over the well was 70 feet in height, and the oil column occasionally rose to at least double this height, while stones were distinctly seen to be projected to an even greater altitude. An American who was with me said he could compare the spectacle with nothing but the falls of Niagara, and there was certainly the same awe-inspiring effect in watching nature disgorging her treasure that one experiences when standing on the brink of the stupendous Falls. The photograph exhibited (see Fig. 1) represents a Caucasian oil fountain. The well I saw spouting (Nobel's No. 18) yields at the rate of 1,125,000 gallons per 24 hours whenever opened, and is by no means the most productive that has been struck, the Droojba well and Nobel's No. 9 well having for a time yielded about double that quantity per 24 hours. In the case of these two wells the pressure of the oil amounted to about 200lb. on the square inch, and the oil column was from 200 to 300 feet in height. In the instance of Nobel's No. 9 well no great proportion of the oil was lost before the well was capped, but the Droojba fountain was for no less than four months quite uncontrollable, and it is estimated that from 68,000,000 to 136,000,000 gallons were ejected during this period. This quantity of American crude oil was worth in the United States at the time from £700,000 to £1,400,000 sterling, but in consequence of the impossibility of storing it, the oil spouted by the Droojba well was practically unsaleable. Not only was the greater part of the oil lost, but great damage was done to surrounding well property, engine houses being buried by the sand thrown up. It may afford a means of realising the enormous productiveness of these wells, if I state that the well known as Armstrong No. 2 struck last

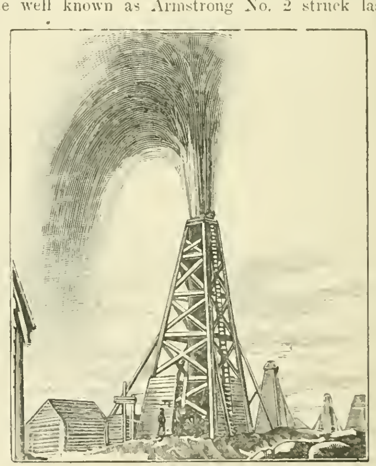

Fig. 1.

autumn in Butler county, Pennsylvania, flowed for a time at the rate of 260,000 gallons per 24 hours, and is considered one of the most prolific wells ever known in the oil regions of the United States. The yield of this well, it will be noted, is only about one-eighth of that of the Droojba well or of Nobel's No. 9 well.

The first step in the operation of boring a well is the erection of a derrick. I have on the lecture table a model made for me in the United States which illustrates the method of construction, derricks of the same form being used in Russia. It will be seen that the structure consists of a timber framework, pyramidal in form and strengthened with diagonal braces. The sides of the derrick are frequently, I may say usually, enclosed with boarding to a considerable distance from the ground, to keep out wind and rain. The height of the structure is commonly about 70 feet, and it is about 20 feet square at the base. Immediately outside the derrick stands what is termed in America the Sampson-post, a massive pillar of wood some 18 inches square, which supports the "walking beam." The walking beam is connected to the crank of the band-wheel by what is called a pitman, and a rocking movement is thus imparted to it

by the steam engine in the adjoining shed. There are two methods of boring in use in the Caucasus, termed respectively the rod system and the rope system, the latter being the more expeditious, and admitting of from 7 feet to 8 feet being bored per working day of 10 hours. In the rod system of boring the bit is screwed into an iron rod which may be as much as 40 feet in length, and a vertical movement is imparted to the apparatus by the walking beam already alluded to. As the hole increases in depth, additional lengths of iron rod are added, in the same way that the chimney sweeper manipulates his machine. At frequent intervals, however, it becomes necessary to remove the detritus from the bore, and when the well has been sunk to a considerable depth (say 200 to 300 feet), the time occupied in unscrewing each rod as the drill is drawn up, and reconnecting the rods after removing the detritus, is considerable. In the rope system, the set of drilling tools, consisting of temper screw, rope socket, auger-stem, the jars, and bit, are suspended by a stout cable of manilla. The aggregate length of this set of tools is over 50 feet, and the weight about a ton. The bits used in America are about 5½ inches in diameter, and are faced with about 40 pounds of steel, but in Baku the wells are of greater diameter and the bits correspondingly larger. As the boring of the well progresses it is cased with iron tubing, which is lowered in successive lengths. Tubing as much as 16½ inches in diameter is occasionally used in Russia, but the usual size with which the casing of the well is commenced is 15 inches diameter, the tubing being added in successive lengths of 7 feet. As the depth of the well increases and the larger tubing can no longer be driven down, smaller tubing is used, and the lower lengths are sometimes less than 8 inches in diameter. I have already stated that from time to time the detritus has to be removed. For this purpose the drilling tools are drawn up through the medium of the strong windlass (technically known as the bull-wheel) fixed to the side of the derrick, and actuated by the same steam engine that moves the walking beam, and then a few bucketsful of water having been poured into the well, the "sand pump" is lowered by means of a small windlass. This sand pump consists of a tube or cylinder of metal some 6 feet or more in length, having at the lower end a valve opening inwards. The detritus having entered the tube through the opening of the valve, the tube is withdrawn with its contents, and this operation is repeated as many times as are necessary. The cost of sinking a well is about £2000, more or less, according to circumstances, the irregular character of the strata rendering the operation more difficult and costly than it is in the United States. As soon as oil is struck, the great anxiety is to affix a cap to the upper end of the well tubing before the flow becomes unmanageable. A difficulty arises from the fact that the oil contains a great deal of sand, the violent flow of this sand-laden oil quickly cutting through a considerable thickness of iron. I saw in Balakhani several caps which had thus been rendered useless. The caps used are provided with a valve so that the flow may be controlled and regulated. In many cases it is found necessary to artificially strengthen the ground surrounding the well, in order to prevent the oil from making its way to the surface outside the tube when the flow is checked, and in the case of some wells the closing of the valve is attended with the risk of the cap being blown off by the immense pressure of the oil. It has more than once happened that on the oil being struck the outflow has taken place with such violence that the drilling tools, weighing as I have said a ton, have been projected from the bore. The employment of nitro-glycerine for increasing the production of a well, so common in the United States, has not, I believe, hitherto been resorted to in the Caucasus.

It is stated that there are over 400 wells in the neighbourhood of Baku (as compared with more than 20,000 in the oil-fields of the United States), but of these I was informed that only about 100 were at the time of my visit producing. Rather more than half the producing wells are owned by the firm of Nobel Brothers. Of the 100 wells only some 20 are flowing wells, the remainder requiring to be pumped; but from what I have stated as to the productiveness of the fountains, it will readily be believed that if the oil were allowed to flow, these 20 wells would for a time yield far more than sufficient raw material for the manufacture of the 1,800,000 gallons of petroleum burning oil which the world is now daily consuming.

The oil containing too much sand to admit of ordinary pumping, it is lifted to the surface by a contrivance similar to that which I have described as being employed for removing the detritus during the sinking of the well. The valved tube thus used holds about 45 gallons, and it is stated that from 18,000 to 22,000 gallons can thus be raised from each well per working day of 10 hours.

The average depth of the wells last year was 450 feet, having been in 1873, 154 feet; in 1880, 273 feet; and in 1882, 350 feet. It is estimated that the average level of the oil is lowered to the extent of 56 feet for every 500 million gallons extracted.

The No. 18 well (Nobel Brothers), which I saw spouting, has a depth of 721 feet. The boring was at first stopped at 500 feet, but the flow having ceased, the well was deepened. This well was struck three years ago. The depth of the famous Droojba well is 574 feet. I may add for comparison that 1500 feet or more is now by no means an uncommon depth for petroleum wells in the United States.

Soon after the annexation of Baku by Russia in 1801, the attention of the Russian Government was turned to the natural wealth of this district, and the production of petroleum was at first farmed out as a monopoly to Meerzoeff. This continued till 1872, and from then till 1877 there was an excise duty. During the period extending from 1821 to 1872 the yearly revenue from the petroleum monopoly was never far short of, and often exceeded, 100,000 roubles, and in the latter year it had reached the sum of 136,000 roubles. The output increased from 3565 tons in 1840 to 24,800 tons in 1872, but in two previous years—viz., 1869 and 1870—the output exceeded 27,000 tons. In 1872 there were only two drilled wells, in addition to 415 pit wells, and the price of the crude oil was 45 copecks per pood (about £3, 10s. per ton). The following tabular statement shows the growth of the industry from the time when the monopoly was abolished:—

PRODUCTION AND PRICE OF CRUDE PETROLEUM.

	Tons.	Price per Ton. s. d.
1873	61,000	7 9
1874	78,000	6 3
1875	91,000	15 6
1876	194,000	7 9
1877	242,000	12 6
1878	320,000	8 8
1879	370,000	6 3
1880	420,000	3 8
1881	490,000	2 6
1882	680,000	2 6
1883	800,000	2, 6 to 0 3½
1884	1,130,000	

The production of crude petroleum in the United States for 1884 has amounted to about 3 million tons, and the price has ranged from about 16/- to 32/- per ton.

The specific gravity of the crude oil is usually

between ·870 and ·875; some wells have, however, yielded oil as heavy as ·885, and others oil as light as ·850. The specific gravity of the oil first obtained from Nobel's No. 18 well was ·860, but upon the well being deepened the specific gravity fell to ·854. The specific gravity of the crude oil now found in Pennsylvania ranges from about ·800 to about ·820. I have placed on the table samples of Russian and United States crude oil for comparison.

The crude oil is in the first instance conducted from the well through wooden channels to ponds or lakes, where it deposits the sand held in suspension, and it is then pumped into storage tanks prior to being piped to the refineries.

Formerly—that is, up to 1875—the transport of the oil to the refineries took place exclusively in the Persian carts or "arbas" I have already mentioned. These strange-looking vehicles are entirely constructed of wood, the body of the cart simply resting on the wooden axle, and the latter revolving with the wheels, which are often 8½ to 9 feet in diameter. The felloes of the wheels, being unprotected by tyres, are made of great depth to allow for the rapid wear to which they are subjected in traversing the rough roads, and the wheel becomes in use of smaller and smaller diameter until its dissolution, which generally seems to occur unexpectedly at the most inconvenient time. In these carts two casks were conveyed, one in the body of the vehicle, and the other slung beneath the axle. Thousands of these carts were in use prior to the era of pipe-lines: it is stated that as much as £100,000 per annum was paid for thus transporting the crude oil.

The first pipe-line from the wells to the refineries was laid by Messrs. Nobel Brothers, in the face of the most determined opposition on the part of the proprietors of the "arbas," who recognised that their business was threatened with extinction; and it is evidence of the lawlessness prevailing in the Caucasus that Messrs. Nobel were compelled to erect a line of watch-houses, wherein they stationed armed men to guard their pipe. Pipe-lines have some time since been accepted by the native carters as a necessary evil, but there is still much jealousy among the well-owners and refiners, and as the Tartars have no scruples about taking life, it is not safe for the visitor to traverse the district around Baku after dark without an armed escort, while even in daylight it is well to carry a revolver.

At the present time there are seven pipe-lines for the conveyance of crude oil, the two largest, which are of the respective diameters of 6in and 5in., being the property of Messrs. Nobel Brothers. A certain amount of crude oil is also transported to the refineries by rail. More than 700 millions of gallons per annum could thus be delivered at the refineries, the Nobel Company's two pipes alone having a carrying capacity of 176 million gallons per year. Several telephone wires connect the wells with the refineries.

II.—Refining.

There are about 200 refineries in the Tchorni Gorod or Black Town, at Baku, but at the time of my visit not more than 50 or 60 were in operation. The works range in size from the primitive Persian refinery, with a couple of stills, to the gigantic establishment of Nobel Brothers, and at all these works petroleum residuum is the sole fuel used.

Messrs. Nobel's plant, for separating the burning oil or kerosine, as we may conveniently term it, consists of a large number of stills, each of the capacity of 4400 gallons, arranged in groups or series of not more than 25, and worked on the principle of continuous distillation, a stream of oil flowing through the entire series. Mr. Nobel informs me that this method of distillation is specially adapted for Russian petroleum, since from such oil only a comparatively small percentage of kerosene is obtained, and the residuum flowing from the stills is almost as fluid as the crude petroleum. The products of distillation are first separated into three fractions, termed respectively benzene, sp. gr. ·754; gasolene, sp. gr. ·787; and kerosene, sp. gr. ·820 to ·822. There is but little demand for the lighter products, and though a certain quantity is sold for detergent and manufacturing purposes, and a further quantity is employed by Messrs. Nobel as fuel, much has to be burned in waste to get rid of it. The kerosene distillate is pumped into lead-lined iron tanks, termed agitators, of the capacity of 57,000 gallons, where it is treated with about 1½ per cent. of sulphuric acid. The acid is forced up to the top of these tanks (which are above ground) by air pressure, and is distributed through perforated coils of leaden pipes, so that it falls through the oil in fine streams. The oil and acid are then subjected to agitation by introducing a blast of air at the base of the tank. After this treatment the acid is allowed to subside, and the oil is drawn off into a similar sized iron tank without lead lining, standing at a lower level. In this tank, which is furnished with a similar method of agitating, the oil is treated with a solution of caustic soda, and is afterwards washed. Fresh water being very scarce at Baku, sea water is used for washing the oil as well as for the condensers. The sea water is brought into Messrs. Nobel's refinery from the Caspian by an aqueduct 5 feet in diameter, the intake being 7 feet below the sea surface, and 300 feet from the shore. The temperature of the water in summer is about 22° R. (82° F.). The kerosene is run from the washing agitators into settling tanks, where it deposits water, and thence is pumped into storage tanks (one of which at Messrs. Nobel's works holds 1½ million gallons), preparatory to being placed in the tank steamers for conveyance to the mouth of the Volga. The whole process of treatment of the distillate occupies from 15 to 16 hours. The sulphuric acid used by Messrs. Nobel is made by them in a separate factory, where 3100 gallons per 24 hours can be turned out. The sulphur was formerly imported from Sicily, but is now obtained from Tchirkat in Daghestan, near the port of Petrovsk on the Caspian. There is at Baku another factory, where sulphuric acid for the use of the other refiners is made. Although there are no laws or regulations in Russia prescribing a test for petroleum, Messrs. Nobel prefer to make a burning oil having a flashing point considerably above that which experience has shown to be sufficient to insure safety in the case of American kerosene, Nobel's oil having a flashing point of about 32° C., when tested by the German modification of Sir Frederick Abel's well-known apparatus. The oil has a specific gravity of about ·821, and is almost free from colour and odour. Of this oil the crude petroleum yields only about 27 per cent., but a much larger percentage of oil of lower flashing point or higher specific gravity could be obtained. Of oil absolutely free from colour, of sp. gr. ·823, and flashing point 50° C., Abel-Pensky test, the crude oil yields about 22 per cent. At another refinery which I visited (that of the Caspian Company), I was informed that the following grades of kerosene were made:—

Quality.	Sp. Gr.	Flashing Point.
1.	·815	30° C.
2.	·820	25° C.
3.	·821, ·822	22° C.

Of the first quality, some of which is exported from Batoum, the crude oil is stated to yield 20 per cent.;

of the second quality, sold in Russia, 33 per cent.; and of the third quality, sold locally for consumption in the Caucasian district, 38 per cent. The crude petroleum of the United States yields not less than 70 per cent. of kerosene.

The residue in the stills after the kerosene has been volatilised has a sp. gr. of about ·903, and is known by the Russian name of astatki, or by the Tartar name of masut. It is usually stored in large excavated tanks, lined with masonry. Messrs. Nobel have a cylindrical tank of this description holding 11 million gallons.

From the astatki, lubricating oil is obtained by distillation, but in Messrs. Nobel's works only about 10 per cent. of the astatki has hitherto been thus dealt with. Of the remainder, Messrs. Nobel use a small portion for the heating of their stills and boilers, and sell the greater part as fuel. The astatki yields about 30 per cent. of lubricating oil, and about 15 per cent. of what is known as solar oil (sp. gr. about ·860 and flashing point about 220° F.—closed-vessel test). The latter is a product intermediate in sp. gr. and flashing point between the kerosene and the lubricating oil, and is capable of being burned in suitable lamps, two of which I have on the table. It has by some refiners been termed pyro-naphtha, and Messrs. Ragosine have introduced it as a "safety burning oil," but so far it has been difficult of sale, and it is usually returned to the astatki and thus employed as fuel. I have on the table specimens of the various products to which I have referred. The crude petroleum of Baku differs from that of the United States in containing little or none of the solid hydrocarbons; some of the crude oil of this district appears, in fact, to be practically free from solid hydrocarbons, and I believe that ¼ is the largest quantity that any of it contains. On the other hand, the petroleum obtained from Messrs. Nobel's wells in the Island of Tcheleken, on the opposite side of the Caspian Sea, yields as much as six per cent. of solid hydrocarbons. It is well known that the paraffin obtained from American petroleum is a source of considerable profit, but while the Baku refiner is at a disadvantage in this respect, he is enabled to make without difficulty or expense a lubricating oil, which bears exposure to a temperature below zero of Fahrenheit's scale without becoming solidified.

There are in the Baku district other refineries besides those situated in the Black Town. One of these (Kokereff's) is at Surakhani, on the site of the Eternal Fires, the distillery immediately adjoining the temple I have already described. This refinery was built with the view of using the natural petroleum gas as fuel, and elaborate arrangements were made for collecting the gas and conducting it beneath the stills, but when I visited the distillery, astatki was being used as fuel. The abundance of natural gas in the neighbourhood of this refinery is shown by the fact that the gas is now, as it has been from time immemorial, largely used in lime burning. There is plenty of limestone rock, and the lime burners simply turn up the surface of the ground and apply a light to the gas.

Messrs. Nobel's refinery is not only the largest, best constructed and best conducted at Baku, but it compares, I think, on the whole favourably with any I have seen in the United States. Portions of it are fitted with Siemens's electric light, and some idea of its magnitude may be gathered from the fact that it contains no less than 45 miles of piping. It covers from 75 to 80 acres, but the total area of the works, if the ground occupied by the houses of the employés is included, is 120 acres. In this connection I may mention that Mr. Nobel has erected a number of handsome dwellings and a club house for the general manager of the works, the chemists and engineers, and has planted gardens which are irrigated with water brought from the Volga.

Mr. Peacock estimates that 8000 men are employed in the petroleum industry at Baku, the common labourers being nearly all Tartars, Persians and Armenians, while the coopers, carpenters and other skilled workmen are Russians, Finns and Swedes. The wages of the former class are as low as 10d. per day or about 25s. per month, while those of the latter class range from £3 to £6 per month.

The following table shows the amount of kerosene manufactured during the last 13 years by Messrs. Nobel Brothers and the other refiners :—

Years.	Nobel Brothers. Tons.	All other Refiners. Tons.	Total. Tons.
1872	..	16,100	16,100
1873	..	21,500	21,500
1874	..	23,600	23,600
1875	..	32,600	32,600
1876	100	57,000	57,100
1877	2,500	75,100	77,600
1878	1,550	93,000	97,550
1879	9,000	101,000	110,000
1880	24,000	126,000	150,000
1881	50,000	133,000	183,000
1882	72,000	130,000	202,000
1883	106,000	100,000	206,000
1884	157,100	191,300	348,100

The price at Tsaritsin was in 1878, 3s. per five gallons, and is now about 1s. 3d.

The total exports of kerosene from Russia for 1884 amounted to 37,900 tons, of which Nobels manufactured 15,000 tons.

I estimate the quantity of kerosene manufactured from American crude petroleum in 1884 at more than two million tons.

The following tabular statement shows the increase in consumption of kerosene in Russia per head of the population. The figures are Russian pounds :—

CONSUMPTION PER HEAD OF POPULATION.

1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882
1·09	1·76	1·93	2·30	2·91	3·07	3·96	4·18	4·43	6·11	6·14

The distilling plant of the Nobel Company would enable them to make per 24 hours, 220,000 gallons of kerosene, 80 tons of lubricating oil, and 1300 tons of liquid fuel, equal to a yearly production of at least 65,000,000 gallons, 27,000 tons, and 450,000 tons of the three products respectively. We have already seen that the quantity of kerosene made by this firm last year was 157,100 tons, equal to 42,700,000 gallons, and it is estimated that the sales of lubricating oil and residuum for the same period amount to 3000 tons and 250,000 tons respectively. If, therefore, Nobel's works were continuously in full operation throughout the year, there would remain a surplus available for export of more than 22 million gallons of kerosene, 24.000 tons of lubricating oil and 200,000 tons of liquid fuel.

The native petroleum industry is protected in Russia by an import duty on American kerosene of 55 copecks per pood, equal to about 3d. per gallon, and since 1873 the imports of American kerosene into Russia have diminished year by year. At the present time practically the whole of the kerosene burned in Russia is manufactured at Baku.

The quality of the kerosene made from Russian petroleum has been the subject of much discussion. When the oil was first introduced into Europe its high specific gravity led to the belief that it would not be found to burn well in ordinary mineral oil lamps. The fact was, however, overlooked that the crude oil yields so small a percentage of kerosene, that this product is necessarily very homogeneous, the various hydrocarbons composing it not differing very widely in specific gravity, boiling point and other characteristics. This feature is clearly shown by the

following results, which I have obtained in fractionally distilling samples of Russian and American crude petroleum and kerosene obtained therefrom. A measured quantity of the liquid was distilled, and each distillate was $\frac{1}{10}$ by volume of the quantity taken for distillation:—

	Baku Crude Petroleum. (sp. gr. ·873)	United States Crude Petroleum. From Bradford District. (sp. gr. ·819)	United States Crude Petroleum. From Parker District. (sp. gr. ·804)
1st fraction—sp. gr.	·787	·725	·721
2nd " "	·812	·753	·742
3rd " "	·839	·776	·760
4th " "	·855	·801	·778
5th " "	·861	·822	·798
6th " "	·848	·836	·818
7th " "	·839	·837	·825
8th " "	·847	·839	·831
9th " "	·857	·843	·846

Remarks.—The distillation was throughout conducted without passing steam into the retort, and there was therefore, especially in the case of the Baku petroleum, some decomposition or "cracking" of the hydrocarbons, accompanied by the evolution of gaseous products, and deposition of carbon. This accounts for the low sp. gr. of the latter fractions of the Baku oil, and for the fact that there was not, in every case, sufficient of the 10th fraction to admit of the sp. gr. being taken. It was, however, only desired to indicate that the Baku petroleum yields comparatively little kerosene, and no arrangements were, therefore, adopted to secure the distillation of the lubricating oil undecomposed.

	Russian Kerosene. (sp. gr. ·822)	American Kerosene (sp. gr. ·803)
1st fraction—sp. gr.......	·783	·748
2nd " "	·796	·759
3rd " "	·803	·778
4th " "	·811	·792
5th " "	·827	·802
6th " "	·831	·812
7th " "	·837	·822
8th " "	·838	·831
9th " "	·846	·838
10th " "	·864	·849

A reference to the tables will show (*a*) that the Russian crude petroleum contains a comparatively small proportion of the lighter hydrocarbons, and (*b*) that in the case of the Russian kerosene there is less difference between the sp. gr. of the lightest and heaviest fractions than in the case of the American kerosene.

lamp was fitted with a Hinks's duplex burner, and two varieties of wick were used. What is termed the American wick was a wick of long-staple cotton loosely woven, the English wick being a comparatively hard, tightly woven wick such as is commonly employed in this country. I may take this opportunity, of stating that I have not found any exception to the rule that all mineral oils burn far more satisfactorily as well as more safely, when a wick of the character of the American wick referred to is used, and I am of opinion that too little attention has hitherto been paid to this important adjunct to the lamp.

It will be noted that the Russian oil did not with either wick give as much light as was afforded by the sample of American oil, but on the other hand there was considerably less diminution in the light as the level of the oil in the reservoir of the lamp fell, and I may state that the latter feature has characterised all the comparative tests I have made of the two kinds of oil. I have tested the Russian oil in various other forms of burner used in this country and on the Continent, and except in the case of a burner in which a metal cone was substituted for the usual glass chimney, I have found that it burns satisfactorily. I have therefore no hesitation in saying that it is adapted for use in ordinary mineral oil lamps.

Russian kerosene is, as I have stated, almost free from colour; that which is manufactured by Messrs. Nobel being what is technically termed superfine white, according to the method of testing and standards of the Petroleum Association. Formerly the colour of refined petroleum was estimated by comparing it with that of a standard sample, the two oils being contained in bottles of the same size. Several years ago I had an apparatus constructed for colour testing, which is now on the table. It consists simply of an arrangement for holding two tall glass cylinders above a mirror in such a position that the images of the bottoms of the cylinders are presented side by side. The oil to be tested being placed in one cylinder, and a standard sample in the other, it is easy to make an accurate comparison of the reflected discs, which are, of course, tinted in proportion to the colour of the liquids. I found this mode of estimating colour preferable, in the case of

	Russian Kerosene.		American Kerosene.	
	American Wick. Standard Candles.	English Wick. Standard Candles.	American Wick. Standard Candles.	English Wick. Standard Candles.
Maximum illuminating power	22·1	19·11	25·59	21·25
Minimum " " after 6 hours	20·5	17·4	22·24	19·16
Average " " during 6 hours	21·2	18·01	23·96	22·14
Percentage falling-off in illuminating power in 6 hours	7·2	9·0	13·0	20·9
Grains of oil consumed per hour	1137	981·6	1238	1213
Grains of oil consumed per candle-light per hour	53·6	54·4	51·6	54·7

I have made a large number of photometric tests of Russian kerosene burning in ordinary lamps in comparison with American kerosene, on various occasions during the past eighteen months, and in the following table I give some of the most recent results obtained, the Russian oil used in these experiments being of Nobel's manufacture, and the American oil ordinary kerosene of good quality. The test

a fluorescent liquid like petroleum, to that of looking down upon the surface of the oil while the tube or cylinder is held over a white surface. Soon after I commenced the regular use of this apparatus, Mr. Robert P. Wilson, a member of the Committee of the Petroleum Association, invented and patented (in 1870) the chromometer now largely used in the trade. This instrument consists of two tubes arranged side

by side and furnished at the lower end with a small mirror, by means of which light may be reflected upwards through them, each tube having a screw cap with glass centre. Above the upper ends of the tubes is fixed a small box containing two pairs of prisms, and above this is an eye-piece.

Up to this time it had been the custom to use standard samples of kerosene for comparison; but these were liable to alter in colour, and it was by no means the least valuable feature of Mr. Wilson's instrument that glass standards were substituted for the liquid standards previously employed. In using the apparatus, one of the two tubes is completely filled with the oil to be tested, and beneath the other tube is placed one of the standards, consisting of a disc of stained glass about the size of a shilling. The mirror is then adjusted so as to project the light through the tubes, and upon looking into the eye-piece a circular field divided down the centre is seen, the halves being tinted to an extent corresponding with the colour of the oil and of the glass standard respectively. The dividing line is formed by the edges of the two pairs of prisms referred to, and the prisms are employed to bring the light from the two tubes into one eye-piece, in the manner shown in the diagram (see Fig. 2):—

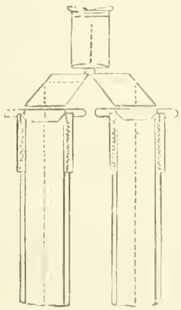

Fig. 2.

Wilson's chromometer was, after a sufficient trial, adopted in 1872 by the Petroleum Association, and is

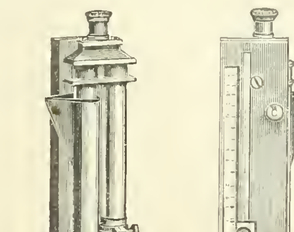

Fig. 3.

now in use in America and on the European continent, as well as in this country.

I have on the table a German modification by Stammer of this instrument (Fig. 3). In Stammer's apparatus, which in principle resembles the chromometer already described, the tube containing the oil under examination is open at the top, and is fitted with an inner empty tube, also open at the top and closed at the bottom by a disc of glass. The inner tube is in the first instance raised to the highest point, and a glass standard somewhat paler in colour than the whole column of oil having been selected, the inner tube is lowered, the oil being gradually displaced and the column of liquid shortened, until the two colours match, when the extent of shortening is read off on the scale. The precise colour of the oil can thus be recorded.

Lubricating oil made from Baku petroleum was, I believe, first introduced into England by Mr. Victor Ragosine, in 1877, and is now sold by the firm of Ragosine and Co., under the registered names of "Oleonaphtha" or "Ragosine Oil," in Germany, France, Austria, and Belgium, as well as in this country. This firm has two refineries on the Volga, north of Nijni Novgorod, capable of turning out a quarter of a million barrels a year. The crude oil and residuum are brought from Baku *via* the Caspian and Volga, and the refined products are conveyed to the consuming countries *via* the Volga and maritime canal to Cronstadt. The water route, though circuitous, is economical, and is likely to be adhered to until the raw material can be piped from Baku to the shores of the Black Sea. The imports of Ragosine lubricating oil into France and Belgium since 1877 amount to 187,000 barrels.

Russian lubricating oil, besides being, as a rule, practically free from solid hydrocarbons, and therefore bearing exposure to very low temperatures, without becoming solidified and thus clogging the bearings of machinery, has a remarkably high viscosity in relation to its specific gravity. This characteristic is very clearly exhibited in the following tabular statement of results which I have obtained in determining the viscosities of samples of Russian and American lubricating oils for the purpose of comparison:—

	Viscosity at 70° F.	Viscosity at 120° F.	Loss in Viscosity per cent.
Russian oil (sp. gr. ·913)	1100	166	88
American oil (sp. gr. ·914)	231	66	71
Russian oil (sp. gr. ·907)	649	135	79
American oil (sp. gr. ·907)	171	58	66
Russian oil (sp. gr. ·898)	173	56	67
American oil (sp. gr. ·891)	81	40	50
A sample of refined rape oil (for comparison)	321	112	65

It has been pointed out that although Russian lubricating oil has a very high viscosity, it rapidly loses its "body" upon being raised in temperature, and a reference to the viscosity figures for temperatures of 70° and 120° F. in the table will show that this is the case, the loss in viscosity between the two temperatures being in the case of a sample having a sp. gr. of ·907, 79 per cent. against 66 per cent. in the case of an American sample of the same sp. gr. Where it is desirable, however, to employ an oil of high viscosity at comparatively low temperatures, as in the lubrication of slow running heavy machinery, the Russian product is superior to the American. Moreover, it may be urged that it is because of its high viscosity that Russian lubricating oil is so much affected by a rise of temperature, for it will be noted that in the case of the American oils, as well as in that of the Russian oils, the diminution in viscosity is in proportion to the viscosity, the oils of greatest body being most affected. It is well known that mineral lubricating oils possess, as compared with fixed oils, the advantage of not being liable to

decomposition under the influence of high pressure steam, or to oxidation. They are, therefore, well adapted for the lubrication of engine cylinders, and cotton waste used to absorb them is not liable to spontaneous combustion.

I have already stated that petroleum residuum or astatki is the only fuel employed in distilling petroleum at Baku. The most simple manner in which this fuel can be used is that which is adopted in the primitive Persian refineries, where the fluid is allowed to trickle upon the floor of the furnace beneath the still, and to burn there. The combustion is, however, under these circumstances, very far from complete, and volumes of black smoke are evolved. This smoke hangs in dense clouds over the Tchorni Gorod or Black Town of Baku, and is particularly offensive and destructive of wearing apparel and furniture, as it is so highly charged with oily particles of carbon that it may, in fact, be termed vaporous black paint. At the Nobel Company's refinery and some others efficient arrangements for the combustion of the astatki are adopted, and little or no smoke is evolved. Before I proceed to describe these arrangements, it will be convenient to consider briefly the development of the use of liquid fuel. As long ago as 1862 patents were taken out in the United States by Bidley, by Shaw, and by Linton, for the use of liquid fuel, and in 1864 experiments were made, at Woolwich, with an apparatus invented by Richardson. Aydon and Shpakovsky in 1865 independently devised arrangements for injecting the fuel into the furnace in the condition of spray, the former using at first superheated steam, and afterwards ordinary steam for the purpose, while the latter employed a blast of air. In the same year, Professor Rankine gave his attention to the subject, and in 1877, H. St. Claire Deville commenced a number of experiments at the request of the Emperor Napoleon III. Deville's apparatus was put to a practical test in Russia by Kamensky, and afterwards by Lentz in 1869, but proved a failure. In 1879 experiments were made at the Brooklyn Navy Yard, in the United States, with a mixture of crude petroleum and pitch, blown into the furnace by a jet of super-heated steam, and a very high temperature was obtained, iron being melted in 10 minutes and glass in 2 hours, as compared with 2 hours and 16 hours respectively when coal was employed as the fuel. In 1870, a steamer called the "Alexai" was fitted with an improved apparatus by Shpakovsky, and a successful result was obtained. Meanwhile, Lentz had also improved his apparatus, and either the Lentz oil burner, or some modification of it, is now employed in the better conducted refineries at Baku. The diagram (see Fig. 4) shows the construction of one of these modifications (Kaufman's) which has been adopted by the Russian Government for use in torpedo boats, the cylindrical flame afforded being well suited to the boilers of these boats. The astatki and steam meet at C D (see Fig. 4), where, by means of two screws, a fissure is opened through which they escape. The apparatus consists essentially of an arrangement for spraying, or, as it is termed in Russia, pulverising the oil by means of a jet of steam, a tongue of flame being in this way projected into the furnace. In thus using liquid fuel for the generation of steam, it is of course necessary in the first place to take a supply of steam from a small auxiliary boiler, or to raise steam by the use of wood or other fuel. The greatest objection to this kind of apparatus lies in the fact that the intensely hot pointed flame is liable to have a prejudicial effect upon the boiler, and it has been found necessary to employ screens of fire-clay, against which the flame is directed. Minor objections to the system are that it is wasteful (for, besides the loss of steam, the heat obtained from the astatki is from 10 to 20 per cent. less than it is capable of yielding), and that it is noisy, the roar of the blast being, in some cases, very objectionable. Nevertheless, the apparatus is very largely used, more than a hundred steamers on the Caspian and Volga, including those employed by the Nobel Company for the conveyance of kerosene, being fitted with it. Nobel's steamers, I may mention, consume 29 tons of astatki on the voyage from Baku to the mouth of the Volga and back. It is a novel experience to look into the stoke hole of a Caspian oil-burning steamer. Instead of grimy toiling firemen and coal trimmers, there is a single attendant whose sole duties consist in regulating the cocks supplying the astatki and steam. Consulting the pressure gauge from time to time, this attendant is able so to regulate the heat that there is neither a scarcity nor a superabundance of steam.

Liquid fuel is also now largely used on the Russian railways, including the Trans-Caucasian and the Griazi-Tsaritsin lines. In regard to its employment on the latter railway, Mr. Urquhart stated last year in *Engineering* that the combustion was smokelessly perfect, and that a practical evaporation of 12 to 13½lb. per lb. of petroleum was possible. He added that 3 or 4 tons of astatki can be run into the tank on the tender in about 4 minutes, the supply of water being taken in at the same time.

While travelling by train from Baku to Batoum, I noticed that although no smoke was emitted by the locomotive, there was occasionally a disagreeable odour of imperfectly consumed petroleum, but I have no doubt, that when the arrangements for burning astatki in such boilers are perfected, this source of annoyance will be removed.

Experiments with a stationary boiler in Messrs. Nobel's works show that one pound of astatki sprayed as described, vaporises 12lb. of water while the same quantity of coal only vaporises from 7 to 8lb. in the same boiler.

In consequence of the objections attaching to the steam-spraying method of burning astatki, Mr. Nobel has made a large number of experiments with the object of devising an apparatus in which satisfactory combustion of the fuel might be attained without the use of steam, and has recently patented an arrangement which appears to answer the purpose admirably. The apparatus consists essentially of a series of shallow receptacles or troughs, so arranged one above another at the mouth of the furnace, that the burning astatki flows by successive stages from the highest to the lowest. I have on the table one of these troughs, and the diagrams (Figs. 5, 6, and 7) illustrate a more recent form, as well as the method of applying the apparatus to the heating of steam boilers.

With this apparatus no less than 14½lb. of water can be vaporised by the combustion of 1lb. of astatki, the heating effect of the liquid burned under the two conditions described, as compared with coal being, therefore, as follows :—

Practical evaporation per 1lb. of fuel in a steam boiler at Messrs. Nobel's works.

Coal	7 to 8 lbs.
Astatki steam sprayed	12 ,,
Astatki burned with Nobel's system of troughs	14½ ,,

The most remarkable results have, however, been obtained in the use of Nobel's trough burner for metallurgical purposes. In a furnace at Mr. Nobel's engineering works at St. Petersburg I saw wrought iron reduced to a state of fusion, and horse-shoes, spanners, toothed wheels and other articles of soft iron can thus be easily and cheaply produced by casting in moulds. I have on the table specimens of this kind of iron work, notably a spanner, which has been bent double under a hammer without showing any signs of fracture. These results have been obtained

DIAGRAMS TO ILLUSTRATE PAPER ON RUSSIAN PETROLEUM INDUSTRY BY MR. BOVERTON REDWOOD.

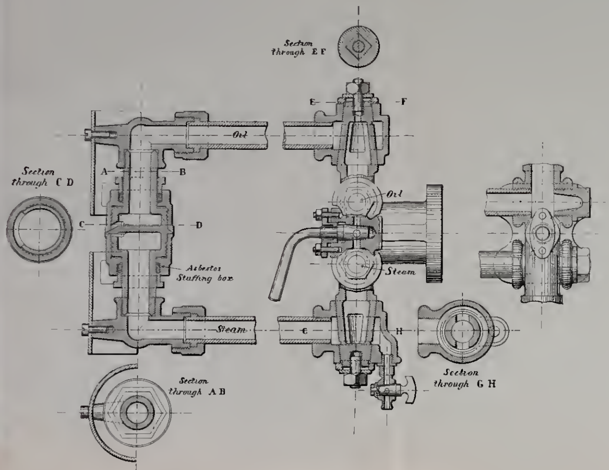

FIG. 4.—Kaufman Burner.

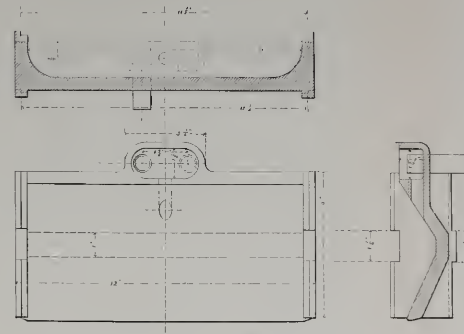

FIG. 5.—Nobel Burner (Trough).

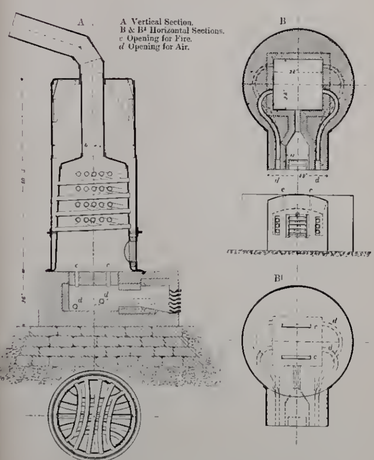

FIG. 7.—Nobel Trough Burner applied to Vertical Steam Boiler.

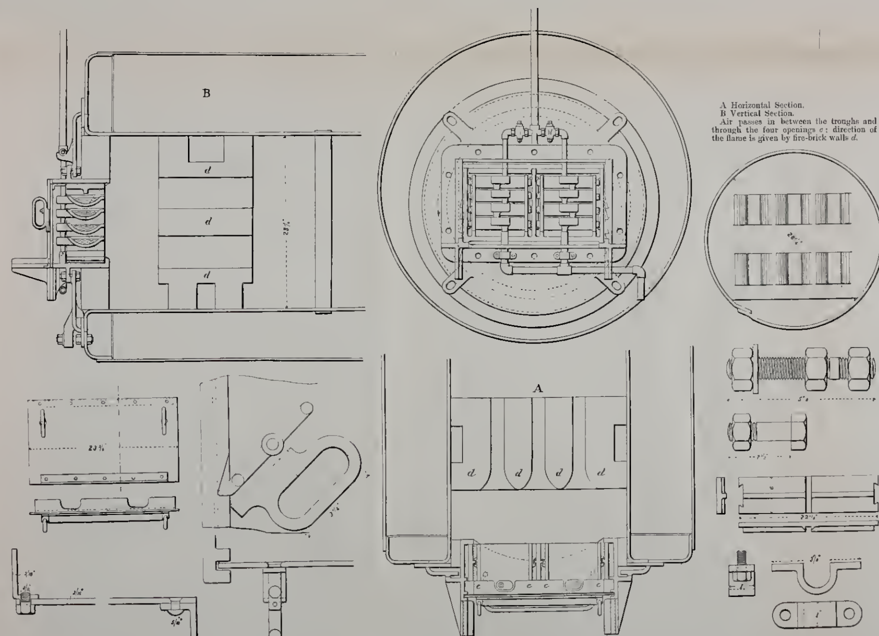

FIG. 6.—Nobel Trough Burner applied to Horizontal Steam Boiler.

without any heating of the air supply; and there can be no doubt that if the air required for the combustion of the fuel were previously brought in contact with heated surfaces, much higher temperatures might be commanded. The difficulty of finding sufficiently intractable materials for the furnaces has, however, hitherto stood in the way of making experiments in this direction. Liquid fuel is thus practically applied for the fusion of iron and brass in Baku; and it is found that old scrap iron may, in this way, be converted into a valuable soft grey pig iron. The employment of astatki for metallurgical operations is largely extending, and the freedom of the fuel from phosphorus and sulphur gives it a great advantage. The cost of astatki at Baku is about 2s. 6d. per ton, and it can be delivered at Tsaritsin, on the Volga, at about 8s. per ton. It is now much used in Moscow, and in localities as far distant as Stockholm and Teheran, no less than 1,500 tons per annum being shipped to Persian ports. Among the advantages of liquid fuel for steamships may be mentioned economy of space in stowage, as well as of labour and time in placing the fuel on board and supplying it to the furnaces, and the smokeless character of the combustion; the last-named being an important point in the case of ships of war.

We have now to consider a feature of the Russian petroleum industry, which is of special interest to the chemist, and seems destined to be of great commercial importance. I refer to the employment of astatki as a source of benzene, anthracene and naphthalene. The process employed can scarcely be said to have passed beyond the experimental stage; but the apparatus I saw was of considerable size; and I am assured that the trials have been conducted on a scale sufficiently large to demonstrate conclusively the practicability of the mode of operating. The astatki is decomposed in a cupola regenerative furnace, which has been patented by Mr. Nobel, to whom I am indebted for the following interesting particulars of the results obtained. The first destructive distillation gives from 30 to 40 per cent. of tar, containing from 15 to 17 per cent. of 50% benzol. By a second destructive distillation of the heavy oils remaining in the tar after the separation of the benzol, 70 per cent. of tar is obtained, containing from 7 to 10 per cent. of 50% benzol, 16 per cent. of naphthalene, 2 to 3 per cent. of dry "green grease" (or 30% anthracene), and 24 per cent. of pitch. There is also obtained in the process 75 to 100 cubic feet per cubic foot of astatki of gas having an illuminating power five times greater than that of coal gas. The regenerative furnace is first heated to 1000° C., astatki being, of course, used as the heating agent, and when it has become cooled in the process of decomposing the astatki it is again similarly heated, the gas remaining in the furnace and the coke deposited on the hearth being utilised as fuel. The furnace is stated to remain in working order without cleaning for twelve months. The world's consumption of benzol is probably not less than 7000 to 8000 tons per annum. London gas-tar contains about 1 per cent of 50% benzol and 1 per cent. of 30% anthracene.

III.—Distribution.

The most remarkable illustration of the forethought, energy and enterprise which have throughout characterised Mr. Ludwig Nobel's action in the petroleum trade is afforded by the admirable system of transportation and distribution, which he has elaborated. It is well known that refined petroleum is usually carried in casks, holding about 40 gallons, or in tins of four gallons enclosed in twos in wooden cases. The latter package is comparatively costly, and is only employed in the case of oil intended for use in hot climates; and as Russia produces but little timber available for barrel making, the difficulty of transport appeared likely to seriously interfere with the development of the trade. Under these circumstances Mr. Nobel conceived the plan of conveying the oil in bulk from Baku in tank steamers, tank barges, and tank railway waggons, to large storage tanks, whence it could be distributed in comparatively small quantities, in barrels which could be returned to be refilled. This system has proved perfectly successful; and it is not too much to say that without its adoption the petroleum trade in Russia could not have reached its present magnitude. Tank railway cars had been employed for the conveyance of crude petroleum in the United States, long before Messrs. Nobel Brothers commenced using them in Russia; but I am not aware that this method of transporting refined oil had been adopted in America. The credit, however, of having carried to a successful issue the shipments of petroleum in tank steamers, undoubtedly belongs to Mr. Nobel, previous experiments in this direction having proved unsuccessful.

The tank steamers employed by Messrs. Nobel Brothers were constructed at Motala in Sweden, and were floated in halves through the excellent canal system which Russia possesses to the Volga, where the forward and aft portions were united. These vessels are about 250 feet in length by about 28 feet in breadth, and have a draught when loaded of from 10 to 12 feet. The whole of the bows and forward part of the steamer forms one large cistern, furnished with two longitudinal bulkheads, and several transverse bulkheads to prevent oscillation of the liquid when the vessel is rolling in a heavy sea. The engines and boilers are amidships, and aft of these are two cylindrical vertical tanks, of a diameter about equal to the beam of the vessel, rising somewhat above the level of the deck. The general appearance of the vessels is shown by the photograph on the table. The total capacity of the tanks is about 225,000 gallons (equivalent to 5,500 barrels of 40 gallons each). The steamers are driven by screw propellers, and the engines are of 120 horse power, nominal. The fuel used is astatki or petroleum residuum, and the speed attained is about 10 knots per hour. Of such steamers Messrs. Nobel Brothers have, on the Caspian, 12. There are also half-a-dozen smaller steamers owned by other firms.

While loading, the steamers lie alongside piers extending into the sea from the neighbourhood of the refineries, the oil being conveyed on board through 8in. pipes, and the cargo of oil can thus be placed in the vessel in 4½ hours.

From Baku to the mouth of the Volga is a voyage of a couple of days, the distance being about 460 miles; but the Caspian is a stormy sea, as I found to my inconvenience, and in the short trips which the steamers make the system of tank transportation has been severely tested, and has been proved to be free from risk. It is true that the prevailing winds on the Caspian are either north or south, and, therefore, dead ahead or astern; but if tank steamers can traverse this sea without accident, there is probably no reason why they should not safely cross the Atlantic, and I doubt not that in time American petroleum will be shipped in bulk.

The Volga at its wide mouth is extremely shallow, and the tank steamers can proceed no further than a locality termed Nine Feet Soundings, about 20 miles from land, and 80 miles below Astrakhan. Here the oil is transferred to tank barges, in which it is conveyed to Tsaritsin (a distance of 284 miles from Astrakhan) or other distributing centres on the Volga, the transport of the oil from the Baku refineries to Tsaritsin occupying six days. There are 38 tank barges on the Volga, of which 20 are owned by Messrs.

Nobel Brothers. At Tsaritsin Messrs. Nobel Brothers have 15 storage tanks (holding collectively six million gallons), railway sidings, cooperage, etc., and the electric light is employed to facilitate work at night. There are also at this place some 30 tanks, of an aggregate capacity of nearly nine million gallons, belonging to the Caucasus and Mercury Company, and other firms; but many of these tanks are for the storage of residuum, while all except one of Messrs. Nobel's tanks are for burning oil.

From the storage tanks at Tsaritsin the oil is run into tank railway waggons, or barrelled, for conveyance by rail into the interior of Russia. Messrs. Nobel have on the Tsaritsin-Griazi railway 1,500 tank waggons, similar in form to those used in the United States, each waggon holding about 2,600 gallons of oil. A train is usually made up of 25 waggons, and thus Messrs. Nobel have 60 trains engaged in the conveyance of refined petroleum from Tsaritsin to their storage tanks throughout Russia. The railway company have also a considerable number of tank waggons of their own for the conveyance of the petroleum of other firms.

Messrs. Nobel have at Tsaritsin a barrel factory capable of turning out 500 barrels per day, much of the wood used being brought from Siberia by way of the river Kama.

The Nobel Company have established their principal storage and distributing centre at Domnino, near Orel, in Central Russia, where they have tanks capable of holding 18,000,000 gallons. They have also ex-extensive tankage at Moscow, St. Petersburg, Warsaw, Saratow, and 23 other places, chiefly in Russia, the total storage thus provided being more than 36 millions of gallons. The necessity for providing for so large an accumulation arises from the fact that the Volga navigation being closed from the latter part of November to April, the year's supply must be conveyed into the interior of Russia and placed in storage during eight months. An interesting feature of the working of this system of tank-waggon distribution may be witnessed at Messrs. Nobel's office in St. Petersburg. A map of Russia is marked with the various depôts and connecting railroads, and the clerk in charge being furnished from time to time throughout the day with telegrams informing him of the movements of the 60 petroleum trains, indicates the position of each train on the map by means of a small flag.

Until recently Messrs. Nobel were fully occupied in supplying the home demand for burning oil, but during the past year they have transported a considerable quantity across Russia into Germany, Austria and Belgium, and it is contemplated to ship oil from Libau in tank steamers.

The following estimate of the cost of Russian kerosene delivered in Stettin has been published by the Nobel Company:—

	Per Gal.
Cost of the kerosene delivered at Tsaritsin on the Volga, including general charges and a reasonable profit	$1\frac{5}{8}$d.
Railway freight in Nobel's tank cars from Tsaritsin to Libau	$1\frac{5}{8}$d.
Charge for wear and tear of tank cars	$\frac{1}{4}$d.
Freight from Libau to Stettin	$\frac{5}{8}$d.
Proportionate cost of barrel at Stettin, with storage, discharging and leakage	$1\frac{7}{8}$d.
Total cost	6d.

Other firms have followed the example of Messrs. Nobel in the organising of bulk transport. The Caucasus and Mercury Company propose to provide tank steamers and barges capable of conveying 120,000 tons of oil from Baku to Tsaritsin on the Volga during the eight months that the navigation of the river is open, and have arranged with a Russian company for the conveyance of the oil from Tsaritsin by rail, and its distribution throughout Russia.

A glance at the geographical position of Baku will show that there are two principal outlets for the petroleum to western countries, viz., by the Volga, and across the Caucasus to the shores of the Black Sea. Hitherto I have dealt only with the former outlet, but as the latter promises to be at some future time of vast importance, I propose to describe it in detail. It is well-known that a line of railway, 560 miles in length, now connects Baku with the port of Batoum. A portion of this line was constructed many years ago, but the section connecting Baku and Tiflis has not very long been completed. It was anticipated that the railway from Baku to Batoum would have furnished a means of transport for large quantities of petroleum, but, unfortunately, from motives of economy, the older portion of the line was carried over what is known as the Suram Pass which has an elevation of 3,000 feet above sea level, and the gradient being in some places as much as 1 in 22, a train is limited to only six tank cars, though two Fairlie engines are used to draw it up the incline. The line also being a single one the traffic is congested, and I was informed that the transport of petroleum from Baku to Batoum, which costs about 1d. per gallon, has recently occupied from four to fourteen days. In order to overcome the difficulty, it is proposed to establish a storage depôt on the Baku side of the pass about 160 miles from Batoum, where the tank cars would discharge their contents, and from this point to lay a pipe line over the pass to Batoum so that the oil may be pumped up to the highest point and allowed to flow down to the shores of the Black Sea. It is the opinion of competent persons with whom I discussed the subject, that before Batoum can become a very important place of shipment for Baku petroleum, either the pipe line to which I have referred must be constructed, or the railway improved by laying a second line of rails and making a tunnel five miles in length through the Suram Pass.

The cost of the pipe line is estimated at three millions of roubles, while the tunnel would probably cost eight to ten millions of roubles. In any case extensive tank storage must be provided at Batoum, and it is thought that if, pending the construction of a pipe line or tunnel, there were adequate means of receiving and storing the oil at this port, the present railroad, if properly managed and provided with the necessary rolling stock, would be sufficient for the transport of from 40 to 50 millions of gallons per annum. Mr. Burkhardt of Batoum, informs me, in a letter received recently, that during the year 1884 there were shipped from that port about 14,500 tons of kerosene, 4500 tons of lubricating oil, and 4700 tons of astatki or residuum; a total of rather more than 6,400,000 gallons.

When I travelled over the line there were nominally 400 tank waggons for the conveyance of petroleum, but I was informed that less than 300 were available for use. I have, however, quite recently learned that the Russian Government has authorised the expenditure of 5,000,000 roubles in improving the means of transport of petroleum across the Caucasus, and that 750 new tank cars, 28 Fairlie locomotives, and extensive tank storage at Batoum and other points are at once to be provided. The sum of 3,000,000 roubles is now being spent upon harbour works at Batoum, and it is possible that before long petroleum may be shipped in tank steamers from this port.

The following table, for which I am indebted to Mr. Sacker, gives the distances in Italian miles of

some of the principal petroleum markets of the world from Batoum and New York respectively :—

To.	From Batoum.	From New York.
Alexandria	1312	5030
Algiers	1978	3586
Amsterdam	3317	,,
Antwerp	3185	3318
Bremen	3142	,,
Havre	2990	,,
Genoa	1910	4075
Gibraltar	1810	,,
Hull	3242	,,
Hamburg	3152	3576
Leghorn	1855	,,
Liverpool	3110	3000
Lisbon	2121	2980
London	3190	3210
Malta	1117	,,
Marseilles	2011	3913
Naples	1586	4200
Palermo	1507	4145
Smyrna	860	4882
Trieste	1768	1982
Constantinople	582	5260

At the present time practically the whole of the tank storage at Batoum is owned by Mr. Palaschkowsky, who has also a factory fitted with all the newest American machinery for turning out 6,000 tins and 3,000 wooden cases per day. I have already referred to this form of package as employed in the shipment of petroleum to hot climates. The cost of the complete case made in Batoum is 92 copecks (less than 2s.), viz., 28 copecks for the wood case and 32 copecks for each tin. American barrels are worth in Batoum about 6s. 6d. and barrels made in Baku cost about 8s.

It is contemplated to provide a third outlet for Baku petroleum by the construction of a railway line from Petrovsk, on the Caspian Sea, to Vladikavkaz. The line would be about 160 miles in length, and its estimated cost is rather more than £1,500,000 sterling. It has also been proposed to connect Novorossisk with Vladikavkaz and Baku with Petrovsk by rail.

The astatki is usually conveyed from Baku to Tsaritsin and other points on the Volga in sailing vessels and barges. When this fuel can be cheaply conveyed to Batoum or Poti it seems likely to compete with coal, of which about 300,000 tons are annually shipped (chiefly from England) to Black Sea Ports.

The two principal routes to Baku are (1) *viâ* the Black Sea and Transcaucasian Railway, and (2) *viâ* the Volga and the Caspian Sea. For those who can spare the necessary time, I would strongly recommend from personal experience the following circular tour :—London to St. Petersburg, *viâ* Hamburg, Copenhagen, Gothenburg, and Stockholm. St. Petersburg to Nijni Novgorod, *viâ* Moscow. From Nijni Novgorod down the Volga to Astrakhan. Astrakhan by steamer to Baku. Baku to Batoum by Transcaucasian Railway. Batoum to Constantinople by Austrian Lloyd's steamer, touching at Trebizonde and other places of interest, as well as great natural beauty on the coast of Asia Minor. Constantinople to London by the Orient express, or if time permits, home by way of Athens and the Adriatic. This journey is not far short of 8,000 miles in length, without the detour to the Piræus, and occupies about two months, including a reasonable time spent at various places of interest. It may be materially shortened by proceeding overland to St. Petersburg and by taking the rail from Moscow to Tsaritsin, thus cutting off a good deal of the tedious, but in some respects interesting, Volga journey of 1800 miles from Nijni Novgorod to Astrakhan. The Constantinople route home is also by no means the shortest from Batoum, and those who are pressed for time should take the steamer to Odessa. A route which is highly spoken of by those who have traversed it is from Rostoff-on-the-Don to Vladikavkaz by rail, and thence to Tiflis on the Transcaucasian Railway by road through some of the finest mountain scenery of the Caucasus. The shortest route from London to Baku is *viâ* Berlin, Odessa, and Batoum. By this route Baku is about 2,500 miles from London, and may be reached in 10 or 12 days without material discomfort or fatigue. As Baku is undeniably a hot place in summer, the visitor should not arrive there before the middle or latter part of September, and if the Volga route be selected Nijni Novgorod may thus be visited on the way to Baku before the closing of the great fair.

DISCUSSION.

Professor Dewar, in thanking Mr. Redwood, called attention to the valuable results to be effected by utilising the volatile portion of the products obtained by distillation, for working gas engines.

Sir F. A. Abel, in supporting the thanks, spoke of the application of the least volatile petroleum products as fuel for locomotives and steamers, and said he felt perfectly sure that, not only in the mercantile marine, but from the small torpedo vessels to the large men-of-war, where the saving of space was of such great importance, the introduction of liquid fuel would prove a new era in maritime power.

Replying to an inquiry as to the differences between Russian and American petroleum,

Dr. Armstrong said that Russian petroleum was a material of very great interest to the chemist, as there could be little doubt that it was entirely different in composition from American petroleum. The American oil, it is well known, contained little besides hydrocarbons of the methane or C_nH_{2n+2} series. According to Markovnikoff and Oglobine (*Ann. Chim. Phy.* 1884, [6] 2, 372-484), whose investigations appeared to merit every confidence, the Russian oil contained a very considerable portion of benzenes (pseudocumene, several isomers of cymene, and also of its next homologue), and of other benzenoid hydrocarbons; it chiefly consists, however, of hydrocarbons of the C_nH_{2n} series, *isomeric* both with the olefines or true homologues of ethylene, and with the hexhydrides of the benzenes. These latter hydrocarbons exhibit the closest resemblance to the paraffins; but are of higher density than their isologues. They are attacked by chlorine, yielding chlorinated derivatives ; but on oxidation are completely destroyed without furnishing characteristic products. The following is a list of the hydrocarbons of this group, which have been separated from the Russian oil :—

	B. P.	Densify at 0° C.	Density at 0° of isologous normal Paraffin.
C_8H_{16}	119	·7714grm. per cent.	·7188grm.
C_9H_{18}	136	·7808 ,,	·733 ,,
$C_{10}H_{20}$	161	·795 ,,	·7156 ,,
$C_{11}H_{22}$	180	·8119 ,,	·7557 ,,
$C_{12}H_{24}$	195	·8025 ,, (at 17°)	·7655 ,,
$C_{14}H_{28}$	240	·8190 ,,	—
$C_{15}H_{30}$	247	·8294 ,,	—

Liverpool Section.

Chairman : E. K. Muspratt.

Vice-Chairman : J. Campbell Brown.

Committee :

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Hudson A. Binney.	G. I. J. Wells.
Eustace Carey.	F. Hurter.
John Hargreaves.	H. Brunner.
E. Milner.	A. Norman Tate.
E. W. Parnell.	J. Affleck.

Local Sec. : E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The next Meeting of this Section will be held on Wednesday evening, March 4th, 1885, when Mr. E. K. Muspratt will read a paper on "The Rivers Pollution Bill."

UNIVERSITY COLLEGE, ASHTON STREET, LIVERPOOL,
Wednesday, November 5, 1884.

MR. E. K. MUSPRATT IN THE CHAIR.

ON INSTRUCTION AND EXAMINATIONS IN CHEMICAL TECHNOLOGY.

BY A. NORMAN TATE.

I THOUGHT it might be well to bring before the members of this Society, for the purpose of opening a discussion, some items that I think should be considered with reference to the future progress of chemical industry. The members of this Society deal with processes based upon scientific facts and principles, and for the successful carrying out of these processes, there is required, not only a knowledge of these facts and principles, but a further knowledge and full appreciation of numerous technical details and practical skill in working these out. Now one of the chief objects of this Society is, or should be, the further development of chemical industries, and therefore, the question may be fairly asked, What is the Society now doing in furthering chemical industrial progress, and what else may be done to supplement present work? In one direction something is being done, and that is in the publication of the Journal, which month by month gives important information respecting chemical processes, and the opinions of those engaged in different departments of chemical industry, and thus form a medium of communication between the members that is extremely valuable. I would suggest that we should do something in the way of instructing workmen and others in the several facts and principles on which their work is founded, and training them in practical technical details.

There is very little done in this country, so far as I can see, in actual practical instruction in technology. There are certainly lectures on technology, and certain courses of instruction given in some of the colleges and schools throughout the country, but these courses are too frequently little more than mere lecture instruction, and not to my mind sufficiently practical; therefore, I think this Society may take some steps to encourage more practical instruction bearing upon technical details. Certainly there is much that is extremely valuable in the technological instruction given in Owens College, Manchester; University College, London; The Technical Chair of Chemistry in Anderson's University, Glasgow; and the Finsbury Technical College of the City and Guilds of London Institute, and other places; and the scheme of instruction fostered by this last-named Institution is probably one of the most complete schemes ever put forward, for, although not actually teaching all branches of technology, the Institute's scheme of examination indicates a fine field of technological work for students. But this scheme, admirable as it is, is, as I think, far from perfect, and unless great care is taken may lead up to, and in many cases end in, the answering by written answers certain printed questions, and many of the questions put are such as can well be answered by a clever crammer, destitute of any really technical skill. I have gone carefully through the questions in several subjects, and consider many of them quite unfitted to test technical knowledge. Many of them are such as may be put to elementary students in science subjects bearing upon the technological subject to which they refer, but they are not calculated to test a knowledge of technical details. Then, again, some of our best workmen cannot possibly succeed in such examination. A man may be able to work in a most admirable way and know everything necessary for successful work, but not be able to put his ideas into shape so as to properly describe the process on paper, and until we have a better educated race of workmen (and of course we may hope for that now that elementary education is given to all), such paper examinations are useless to a very large number of our most experienced workmen, who, if they attempted the examinations, would be most certainly plucked.

I therefore think this scheme of the City and Guilds of London Institute faulty and incomplete. But I certainly look upon what I consider its faults, as such only as are incidental to new enterprises, and probably useful additions will be made when further experience is gained. I cannot, myself, consider any system of examination in technology complete unless it includes some test of practical work involving actual supervision, for the very essence of instruction in technology seems to me to aim to give power to do work—that is, not only to understand all that is stated in a lesson, but power to work out in practical shape, with attention to all necessary details, that which is described or shown by the teacher.

I cannot help thinking that something may be done to promote sound instruction and examination in chemical technology by the Council of this Society, and I would suggest that it is advisable there should be appointed a permanent committee of the Society, and that the work of this committee should be to first ascertain what is being done in this and other countries in the way of affording facilities for instruction in chemical technology. The Report of the Royal Commission on Technical Instruction, lately issued, would form a most convenient and instructive source from which to give a preliminary report on the present position of chemical technology. Next, the committee might gather opinions and facts from amongst the members and others, as to the value of existing modes of instruction and examination, and make suggestions that would amend or add to them. And again, suggestions may be gleaned and passed round amongst members as to individual effort in promoting more careful study and working out of technological details—as, for instance, in the way of offering prizes to workmen and others who show themselves most fitted to receive them. The Society of Arts now offers prizes for inventions and work of different kinds, and could not this Society do something in this direction also? When the Royal Commission on Technical Instruction was taking evidence, nothing was done by this Society to afford information, but had such a committee as I suggest been in existence, probably much valuable aid might have been given by it.

In conclusion, I would say that I think we have to strive to give more complete technical instruction to workmen and others before they enter works, than is afforded by the lectures and courses of instruction given in our colleges and schools at the present time; and believing that a committee, such as I allude to, could aid much in promoting a better system of instruction, I suggest that this section passes a resolution asking the Council to consider the subject, and if they think fit appoint a committee.

Mr. MOND said in the early days of the Society this no doubt was one of its objects, but as they had gone on and become more numerous, it had gone into the background. There was a paragraph contained in the original bye-laws which had special reference to the promotion of technical education in chemical industry, but it was omitted in the new bye-laws. It had become a great deal more difficult to deal with any subject of the sort, through

the many sections that had been formed. The consequence was that every step which the Society had to take had to go through the Sections, and opinions taken there; and it was really difficult now to get at the opinion of the Society as a whole, as the yearly meetings are no longer made use of for the purpose of ascertaining the opinion of the Society upon any special subject. His own opinion was that a very great deal was still to be done in the direction of getting technical education, he would rather say scientific education, in England. He would not say of improving it, but he said deliberately, a great deal had to be done in getting it. He certainly personally wished that their Society should do its share, if it could, in this matter. The notions with reference to technical education appeared to be peculiarly mixed up, and he was very much struck with the remarks of Mr. Tate, when he spoke of the young men who went to Owens College and other scientific institutions, and the figure which young working men would make if they had to pass an examination. There seems here to be a confusion between the education which had to be given to workmen and the education which had to be given to men who had to manage works. Surely these two questions should not be mixed up. They were as different as different could be. If it was desirable to give a certain grounding in natural science to working men—men who earn their living by daily wages—this ought to be done by primary schools, by teaching every child in the country a certain small amount of natural science and the general laws which govern the universe. To do more, he, for one, considered impossible. A man who had to earn his livelihood by daily wages could not afford to attend schools the object of which was to teach anything more than what could be taught at the elementary schools. As to teaching technology to men who were to manage works, he was of opinion that as little of it should be taught as possible. There he was at variance with gentlemen who now tried to teach technology. It was absolutely impossible in a school to teach that which was done in works. The only thing they could do was to make him understand the principles which governed what was done in works, by giving a sound scientific education Whatever else was wanted, he could only learn in practice. He thought the suggestion which Mr. Tate had thrown out was desirable to bring under the notice of the Council. His own opinion was that it was very desirable to make the Society as useful as possible.

The CHAIRMAN must say he agreed to a very great extent, if not with all, that Mr. Mond had stated. The fact was that there was a confusion in the minds of all Englishmen as to what technical instruction was, and what scientific instruction ought to be. They could not expect that they could teach in schools how to carry on chemical operations on a large scale. At the same time he thought that in teaching chemistry in their schools and in their colleges, it might be taught in very different ways by different teachers. Passing a pupil simply through quantitative analysis would not qualify him very well for taking part in chemical works. On the other hand, if the pupil had an opportunity of preparing substances in the laboratory on a somewhat larger scale, and carrying on chemical operations there to a greater extent than they did now, he would learn a great deal more of the behaviour of substances, and he would be more usefully instructed than by the courses hitherto given. People who employed chemists in works, knew that some of them differed very much from others, and that those who had been educated in some laboratories were much better fitted than others for their duties. All they could do was to teach science, they could not teach technology in schools. He knew that the Technical Institution in London, of the City Guilds, had endeavoured, and he believed were endeavouring, to teach technology. He thought it was a mistake—he used technology in the *narrow sense* of the word. He thought they would find that they could do very little in that direction, but he hoped they would be able to teach science in a different manner, and they ought to teach it in such a manner as to promote original research both in practical and scientific chemistry. In the course of time, he had no doubt, we should evolve in England some course of instruction which would be suitable for the condition of English manufacturers; but the Germans and some Continental nations who had much longer experience of this question of technical instruction, had, he thought, come to the view which had been enunciated by Mr. Mond, that you practically cannot teach technology in the narrow sense, and the art of carrying out chemical operations on a large scale they could not teach in any school whatever. That experience must be got in the works themselves. This excluded the possibility of carrying out Mr. Tate's desires. At the same time he thought it desirable that this question should be considered by the Society of Chemical Industry; but it was desirable first that they should discuss it in their sections, and if they came to the opinion that it was desirable to have a more general discussion, call the Society's attention to it. The proper way would be to pass a resolution in that section and send it on to the Council, and then it would be fully discussed. The object of the questions in the technological examinations should be to endeavour to find out whether the pupil understood the laws which lay at the basis of all operations in the chemical works. If he did that he would be properly qualified for taking part in chemical works, after he had a certain amount of experience in the works themselves.

Mr. MOND observed that lectures could never do more than give the pupils an idea of the apparatus used and the processes employed. They could not possibly teach how to perform the operations, either to design or use the apparatus. Lectures could only give a general idea of how the thing was generally done. The general idea was exceedingly useful, but it would never enable a man to carry the thing out. They would have to learn it practically in the works themselves. Even when teaching technology, the knowledge which was given was not only imperfect, but it was never up to date. The lecturers on technology could never know, and the text books never contained, the processes actually at work. Usually they were ten years behind the present time, and very often longer than that.

Professor CAMPBELL BROWN was exceedingly glad to have heard the remarks from Mr. Mond, and from the Chairman that evening, because he had long felt there was a great deal of misunderstanding in the popular mind as to what could or ought to be done in the way of technical instruction. The popular idea was that a young man ought to go into a technical college and be taught from the beginning to the end the whole process of making one thing whether soap, alkali, bleach or dye. It was perfectly clear that men did not learn these things without first learning a great many other things, and he was exceedingly glad to hear from Mr. Mond that technical details could only be learnt in the works, and what technical colleges had to do was to teach those who were to go into the chemical works, the laws of nature, and how to observe and report observations correctly. Mr. Tate had remarked upon the system of the City

Guilds Institute. No doubt the examination questions were sometimes very absurd, but they were not more absurd than examinations generally were. He believed it was a fact that examinations would never be able to determine who was the best practical man. They had signally failed to do so in the universities in this country, and probably everywhere else. He believed the system of examinations so enthusiastically carried on at South Kensington, was responsible for a great deal of the mistaken energy which had been devoted to this kind of cramming for science and art examinations. But when they looked away from the examinations, and saw what was being done in the way of teaching, they found a very different account. It was not by examinations, but by the teachers looking over the work from day to day and from week to week, and making a report of what was done, that they could pick out the best boy for practical work. In the ordinary examinations a boy might not be very well on the day he had to write his answers. He had known men who were perfectly capable of becoming senior wranglers that could not pass, because they had the toothache the night before. He was glad the members of the Society were prepared to state their opinion, and whatever the Society did it should be in order to get good preliminary training, to get pupils to observe the laws of nature, and then refer them to the works for technical details.

A discussion took place as to the form the resolution suggested by Mr. Tate should take, but it was ultimately agreed that the discussion should be renewed at a future meeting, when members would have sufficient opportunity of reading the report, or at least the recommendations of the Royal Commission on technical instruction.

UNIVERSITY COLLEGE, ASHTON STREET, LIVERPOOL,

Wednesday Evening, February 4, 1885.

MR. E. K. MUSPRATT IN THE CHAIR.

THE CHAIRMAN stated that he had received a letter from the President of the Society (Dr. Perkin), who was endeavouring to get subscriptions to the Henry Watts Fund. There was enclosed a circular from the Birmingham Section, asking for subscriptions to assist Mr. Watts' widow and children, seeing how much industrial as well as scientific chemistry owed to Mr. Henry Watts. Mr. Muspratt thought they would all agree with him that it was desirable that they should do what they could towards this very worthy object. Mr. Watts did a great deal for chemistry, and his Dictionary of Chemistry was a most valuable work. Perhaps some gentleman would move that the Committee send out invitations to subscribe to the fund.

It was moved by Mr. CAREY, seconded by Mr. A. NORMAN TATE, that the Committee issue a circular, inviting subscriptions to the fund, on behalf of this Section.

The motion was carried.

The discussion on Mr. A. Norman Tate's paper, read November 5, was then reopened by Mr. Watson Smith, who contributed the following paper:—

ON A COURSE OF INSTRUCTION IN TECHNOLOGICAL CHEMISTRY, AND THE DIFFICULTIES AT PRESENT ENCOUNTERED AND TO BE OVERCOME IN THIS COUNTRY.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Owens College, Manchester.

SINCE the subject of "Instruction and Examinations in Chemical Technology" has already awakened interest and discussion in this Section, Mr. A. Norman Tate having led the way with a communication bearing the above title, in re-opening the adjourned discussion, I may perhaps be excused for giving my views on a subject to me of the greatest interest. Taking the subject of general technical education in the first place, the division of the subject-matter made by the Royal Commissioners in their Report, is a fundamentally necessary one, for it is clear, as pointed out by Mr. Mond, that the kind of instruction needed by the different classes of persons engaged in technical pursuits, must from the very nature of things be different. This division is—

Firstly:—The instruction of the proprietors and superior managers engaged in industrial pursuits.

Secondly:—That of the foremen engaged therein.

Thirdly:—That of the workmen;

and this division applies to the chemical industries as to every other branch of applied science. Commencing at the bottom and referring to the ordinary workman, a very elaborate degree of technical education would be out of the question, inasmuch as the people of the working class have neither time nor money to expend in obtaining it, but for boys belonging to this class, the board schools are already doing an enormous work. I need not, perhaps, remind Liverpool men of the great success which has attended the teaching of the principles of science under the auspices of the Liverpool School Board; but as the method of carrying out this scheme of science instruction may not be generally known, I will not apologise for reading extracts from the Report of the Royal Commissioners on the subject.

LIVERPOOL.

"*System of Science Teaching in Liverpool Board Schools.*—With a view to the provision in the curriculum of their schools, of some subject specially calculated to awaken and exercise the observing faculties of the children, the Liverpool School Board, acting on the advice of several eminent scientific gentlemen, in March, 1877, resolved to introduce the systematic teaching of elementary science into their schools. The branches of instruction were selected from the limited number of science subjects included in the fourth schedule of the New Code of that date, viz., mechanics (or, the principles of natural philosophy) for boys, and domestic economy for girls. The instruction given is necessarily based on the syllabus of each subject set out in the schedule, in order to qualify the scholars to earn grants under the Education Department; but in each case the subject, as arranged in the code, has been modified and extended so as to enable it the more readily to be taught by experimental demonstration to large classes of children.

"*Science Demonstrator in Elementary Schools in Liverpool.*—The method of teaching the subjects, which has been found by experience to be capable of producing very beneficial results to the scholars, is to combine ordinary lessons by the teachers of the school with a system of experimental demonstrations given by means of specially appointed demonstrators. The apparatus required for the demonstrations is kept at a central laboratory, and is transferred from school to school, as

required, by means of a light hand-cart. In this way each demonstrator is able to give from 18 to 20 demonstrations per week. In order to simplify the arrangements for the demonstrations as much as possible, by providing for the same demonstration to be given in several schools in succession, the Education Department was, at the commencement of the scheme, requested to provide for the school-years of the different schools to end as nearly as possible at the same time; and this was carried out so far as to admit of the schools being arranged in two groups, the annual examinations of which fall in the autumn and spring respectively. In the case of domestic economy, the demonstrations are given only every alternate week, and the same is the case in the second stage of mechanics (taken by the Fifth Standard), but to the Fourth Standard, just commencing the subject of mechanics, one demonstration is given every week. In the intervals between the demonstrations, the teachers of the respective classes, who are supposed to be present at the demonstrations, are expected to go over with the children the subject of the demonstration; and in many instances their lessons are illustrated by simple experiments; and in order to enable the teachers (the larger number of whom have unfortunately had no special training for the subject) to perform their portion of the work the more satisfactorily, a simple text-book has been specially prepared, containing reading lessons on the subjects of the demonstrations, and exercises to be worked by the scholars. The demonstrations have been given in several of the other elementary schools of the town, not under the Board, on payment by the managers of the schools, of a proportion of the expenses.

"At the present time there is one chief demonstrator, who has also to organise the instruction, and two assistants.

"The cost of the apparatus used in the school demonstrations for the five years during which the scheme has been in operation amounts to about £120, many of the articles having been provided in duplicate in consequence of the large number of classes.

"*Science Tuition of Pupil Teachers in Liverpool.*—In addition to the instruction given to the scholars, special science classes in connection with the Science and Art Department, have been arranged for the pupil teachers, so as to gradually train them to take an intelligent part in the work in the schools. About 70 male pupil teachers attend the central classes in mathematics, acoustics, light and heat, and electricity and magnetism; and about 100 female pupil teachers are under instruction in animal physiology. A short course of lessons in mechanics is also given each year to the male pupil teachers.

"*Liverpool Council of Education.*—Mr. Christopher Bushell explained to us the action of the Liverpool Council of Education, a body of which he is the president. The object of the Council is to connect the Elementary Schools in the city with the Secondary Schools. For this purpose a system of prizes and exhibitions has been established, and independent examiners report on the quality of the papers which are set by them, and the Council acts on this report in their selection of the candidates. From the Secondary Schools the boys obtain an opportunity of passing to the higher colleges or to the Universities of Cambridge and Oxford.

"*Evening Science Instruction in Liverpool.*—A very important feature in the educational institutions in Liverpool, is the systematic series of evening science classes. There are two distinct organisations founded for this purpose, each of which carries on classes under the Department of Science and Art, without interfering with the other. They act as friendly rivals, and the result is that, probably, in no city in the kingdom are these classes more flourishing, or doing better work than in Liverpool. One of these organisations is termed the 'Liverpool School of Science,' the other 'The Liverpool Science and Art Classes.'"

MANCHESTER.

"*Elementary Instruction of the Manchester School Board.*—The Commissioners inspected many of the schools under the direction of the School Board of the city of Manchester. The average attendance in this city for the quarter ending September, 1883, was: Voluntary schools, 25,736; and board schools, 19,992; or 1 in every 7·5 of the population, and the cost to the ratepayers during the last five years has been 2d. in the £. Statistics of the School Board and particulars of the visits paid to the schools will be found in the Appendix, Vol. IV.

"*Manchester Higher Elementary Schools.—Science Teaching and Evening Classes, under School Board.—Manual Work.*—The points of special interest as regards technical instruction are: (1) The foundation by the Board of so-called graded schools, or higher elementary schools, into which the more advanced or most talented children from the primary school can be drafted, and where the higher subjects, especially science and drawing, are taught more satisfactorily and more economically than can be done in a school containing children of all ages and of all stages of progress; (2) The establishment by the Board of a systematic series of science and art evening classes, as well as of evening schools, for providing instruction in reading, writing, and arithmetic, for those who have had no opportunity of learning when young; (3) The establishment of classes for instruction in the use of tools, in two of the Manchester Board Schools.

"*Central School.*—Of the higher elementary schools two may serve as examples. The first and most remarkable of these is the Central School in Peter Street, taken over by the Board in 1880, and now transferred to new and most complete premises in Deansgate. The results of the science teaching in this school are well worthy of notice. Out of a total of 320 boys, 276 have passed Standard VI., and are taught during the day mathematics, physiology, chemistry (both practical and theoretical), sound, light and heat, magnetism and electricity, physical geography, and mechanics. French, too, is taught throughout the school. A girl's higher elementary school forms one-half of the building.

"*Practical Chemistry.* The total grant from the Science and Art Department earned by this school in 1882-3 was £398. Practical chemistry is extremely well taught; no less than 163 boys, of whom 28 are advanced pupils, were engaged in laboratory work in the winter 1883-4, as well as 20 girls, and the new school buildings in Deansgate contain a laboratory well fitted and arranged for 70 boys working at once, with a lecture-room attached seating 100. Every boy in the school learns drawing upon the South Kensington method.

"*Scholarships.*—To the boys' school is attached one for 200 girls, and 20 scholarships exist for necessitous boys and girls from the primary schools. These are of the greatest service, as they form the first step in the ladder by which a talented boy may climb from the board school to the University. Other scholarships take the boy from this higher elementary to the Manchester Grammar School, and others again from that to the University. Several boys have already accomplished this feat.

"*Ducie Avenue School, Manchester.*—The other higher elementary school visited is that in Ducie Avenue. This is a new school containing 900 children in four departments; it cost, with land, fittings, and chemical laboratory, about £11,000. The upper school fee is 9d. per week, the lower 6d. and 4d. Both boys and girls are taught science, and both—viz., 69 boys and 46 girls, work in the chemical laboratory, which is in a separate building, well lighted and ventilated, and having a special class-room attached; of the boys, 136 are in Standards VI. and VII., or above, and of the girls, 96. The grants earned by this school from the Science and Art Department were £112; and this, together with the school pence, more than cover its working expenses.

"These two schools may be taken as an example of what can be accomplished by the School Board in a large city, even with as low a rate as 2d. in the £; and although in appliances of certain kinds these schools are less completely furnished than many Continental schools, your Commissioners have seen none which sur-

passed them in general efficiency, or in the tuition of any special subject, except in that of drawing."

BIRMINGHAM.

"*Birmingham School Board, Science Instruction.*—On the occasion of their visit to Birmingham, the Commissioners met the members of the School Board, and inquired into the system of science and art teaching under the Board.

"*Board School Instruction in Elementary Science.*—Science is taught in accordance with the following syllabus, by a practical demonstrator and assistant (who visit each boys' and girls' department once every fortnight), and by the teacher of the school.

"*Method of Instruction.*—The science demonstrator for the Board (or an assistant demonstrator) gives one lesson fortnightly, of about 40 minutes' duration, to the boys in the fifth and higher standards in each school. These lessons are illustrated experimentally by specimens and apparatus, carried from school to school in a hand-cart.

"Between the visits of the science demonstrator at least one lesson is given to the same class by the teachers of the respective schools (as a rule by a teacher who was present at the demonstrator's lesson, and took full notes of it), and a written examination on the subject-matter of the lesson is also held. The answers are corrected by the class teacher, and submitted to the demonstrator at his next visit to the school. A general examination in elementary science is held yearly.

"*Syllabus of Fortnightly Demonstrations for Boys.*—Specification of a force; nature and action of machines; principle of work. The mechanical powers; conditions of equilibrium; the mechanical advantage; friction. The lever; parts of a lever; three orders of levers. Practical applications of the lever; double levers. Weighing machines; the balance; the steel-yard. The wheel and axle; practical applications of this machine. The toothed wheel; clocks and watches. The pulley; fixed and movable pulleys; the three systems of pulleys. The inclined plane; its principle and applications. The wedge. The screw. Compound machines. Pressure of liquids; surface of liquids; liquids under the action of gravity. The hydrostatic press. The parallelogram of forces. The parallelogram of velocities.

"*Syllabus of Fortnightly Demonstrations for Girls.*—Structure of the human body; names and positions of the various organs; structure of the skin; the teeth. Circulation and respiration; impure air and ventilation. The organs of digestion; the brain and nervous system. Nature of food; necessity for food; quantity required; classification of food. Preparation of food; meat: its composition and culinary treatment. Fish, eggs, milk, butter, cheese: Principles regulating their use and preparation as food. Flour, pulse, peas, beans: their composition and preparation for the table. Starch, sugar, fruits, vegetables: their use as food. Condiments and beverages. Apparatus for cooking: how used. How to maintain the body in health: I. Fresh air and pure water are needful. II. A suitable dwelling, sufficient food, and exercise (work) are also required. The sick room: duties of a nurse. Contagious diseases: their origin and treatment. How to prevent them spreading. Diseases of children: how to help the doctor. Accidents: what to do in cases of cuts, burns, &c.

"*Science Evening Classes under School Board, Birmingham.*—Classes for the evening instruction of pupil teachers are held at two centres, under the regulations of the Science and Art Department. Male pupil teachers take chemistry and magnetism and electricity; and females, physical geography and magnetism and electricity.

"The Commissioners visited the Icknield Street Board School, which has been provided with an excellent laboratory, in accordance with the requirements of the Science Directory. Here some of the senior boys and the pupil teachers have practical laboratory instruction in chemistry.

"Instruction in handicrafts is not as yet given in any of the Birmingham Board Schools, but this matter is under the consideration of the Board."

Thus we see that for those working men having a real love and aptitude for the pursuit of science the evening classes of the Science and Art Department offer ample opportunities, and the abler boys from the primary schools can pass by exhibitions to the higher institutions in the town. *This connection between the higher board schools and the colleges, and even universities, is one which ought to be much extended*, and on this point I desire to lay the greatest stress. In this country, it can at present only be established by the voluntary movement of generous hearts and open hands. On the Continent, in Germany, it follows as an establishment of law, effected by so-called paternal governments, albeit both wise and far-sighted.

The Foremen are usually chosen in our industries, as indeed the name indicates, from the best workmen, and so the education would be much the same as that for the men, and here other characteristics also would come in, helping to raise the men to this next step higher, that of foremen, as conscientiousness, presence, and power of command, physical strength, etc., which certainly do not form subjects for either examination practically or on paper. But still, those of these men who are the best, and have taken fullest advantage of their opportunities, are the ones that must in the end best succeed. That this feeling has now become a common one, is borne witness to by the fact of such large numbers of candidates for instruction in the great centres of industry. Amongst the other means now accessible to the poorest of our countrymen are the evening classes under the Science and Art Department, in which purely scientific tuition is obtained, and most wisely and excellently engrafted on to this is the scheme of the City and Guilds of London Institute for encouraging more specialised knowledge, perhaps we might or ought, I think, to be able to which define as *scientific instruction with a bias in certain directions—viz., the Technological directions.* The *bias* is involved, of course, in the *application* of the science to the *modus operandi* and means adopted, for the realisation by utilising certain of its laws and facts, of produce on a large scale, a larger one for example, than that of the instruction workshop or laboratory. As regards the chemical industries, there is analogy then between the laboratory and the works, and since the proper construction and use of apparatus in the laboratory forms a phase of instruction inseparable from the learning of practical scientific chemistry, so in the case of chemical work on the large scale, the general principles of construction and use of plant and apparatus, must also form a phase of instruction inseparable from the learning of practical chemistry as carried on in the works. I am quite aware that other prominent conditions come in, in the latter branch, and are important, as economics, wear and tear, etc., matters based on long observation and experience, and for all these reasons, it must be plain that only a certain amount, and that not a very large one, can be taught in schools and colleges, of this subject of Technical Chemistry in the full sense. It is a subject for a life practice; but I hold most firmly, as I know by experience, that a certain amount can be taught and usefully taught, and further, that much more can be taught by those who have had at one time or another actual living experience in the works, just as practical and analytical chemistry can be taught best by those who have worked themselves in the laboratory, rather than by those with a mere book-knowledge of the methods used.

As to practical technical skill conferred by knowledge of general scientific principles amongst working-men and foremen, this might not be very specially manifested in some mere rule-of-thumb processes,

supposing the workmen "*were* watched at their work"; the result of such instruction and training will be a general improvement, but nevertheless the "*power to do work*" must be conferred, for is not knowledge power, and power to do work? If, moreover, an objection to the examination scheme of the City and Guilds of London Institute is, that a large number of our present most experienced workmen are unable to express themselves in writing so as to give replies to the questions, we now see from what I have read from the Report of the Royal Commissioners, that the growing generation will not have that difficulty to contend with, and so the Institute will soon outgrow this defect, if it be one. I consider that the examination questions "such as may be put to elementary students in science, bearing upon the technological subject to which they refer, *without testing* the knowledge of technical details," if understood and answered, might be evidence of great good being done, and of a kind, were I the employer of the successful examinees, I should hail with delight; but to draw forth in public examination form from my workmen evidence on paper of a knowledge of technical details in some directions might excite my feelings in quite another direction. These details belong essentially to the works, and the teaching of applied science in the wide and true sense can flourish without them, *for it aims at growth of understanding, reason and intellect*, and not at accumulation of knowledge of special details.

References were made, not very favourably, in the November discussion to science examinations generally, and to those of the South Kensington or Science and Art Department especially, and the well-worn objection of so-called "cramming" was brought against them. It must be remembered, however, that the word *cram* can be only too easily applied. The mind cannot be stored with facts, without these facts being introduced somehow, and the substitution of the word *cram* for *introduce* is often too lightly made. Examinations must be passed, just as competition in business must arise, and just as races must be run in many ways, and in many spheres of work. Such competition is considered a healthy sign. But as regards this alleged "cramming" for Science and Art examinations at South Kensington let us remember some important statements on this head, by no less an authority than Professor Huxley, to wit, that when he looks back at the state of scientific ignorance in this country some thirty years ago, and then regards the present state of comparative enlightenment, he is astonished at the advance, an advance largely due to the effect of the study, reading and work in preparation for the continually recurring examinations of the Science and Art Department.

Now with regard to the first group referred to in the Royal Commissioners' Report—viz., the *Proprietors and Superior Managers*, and their instruction in Chemical Technology and the attendant or involved branches of science. You will have already read in the address of Sir Henry Roscoe at the opening meeting of the Manchester Section, in the number of our Journal for last December, what his views are on the subject of the higher education and training needed by this class, all of which I most cordially endorse. Especially would I call attention to Sir Henry's weighty words on page 594 (paragraph at foot of column one and top of column two), where he points to the highest platform, or school, needed by those who are to be our leaders in industrial science,—viz., that of *original research*, the search after new manifestations of laws and forces, or even after new laws and forces, for only by such search can the closest intimacy of acquaintance with the workings of these laws and forces be attained. Then as regards the wider general education necessary for this class, I would refer to the important words in Vol. I. of Rep. Roy. Com., pp. 515 and 516.

"*Technical Instruction for Proprietors and Managers.*—In determining what is the best preparation for the industrial career of those who may expect to occupy the highest positions, it is necessary to differentiate between capitalists who will take the general, as distinguished from the technical, direction of large establishments, and those at the head of small undertakings, or the persons more especially charged with the technical details of either. For the education of the former, ample time is available, and they have the choice between several of our modernised grammar schools, to be followed by attendance at the various colleges in which science teaching is made an essential feature, or the great public schools and universities; provided that, in these latter, science and modern languages should take a more prominent place. Either of these methods may furnish an appropriate education for those persons to whom such general cultivation as will prepare them to deal with questions of administration is of greater value than an intimate acquaintance with technical details. It is different in regard to the smaller manufacturers and to the practical managers of works. In their case, sound knowledge of scientific principles has to be combined with the practical training of the factory, and, therefore, the time which can be appropriated to the former, that is, to theoretical instruction, will generally be more limited.

"*How Training may be Obtained.*—How this combination is to be carried out will vary with the trade and with the circumstances of the individual. In those cases in which theoretical knowledge and scientific training are of pre-eminent importance, as in the case of the manufacturer of fine chemicals, or in that of the metallurgical chemist, or the electrical engineer, the higher technical education may with advantage be extended to the age of 21 or 22. In the cases, however, of those who are to be, for example, managers of chemical works in which complex machinery is used, or managers of rolling mills, or mechanical engineers, where early and prolonged workshop experience is all-important, the theoretical training should be completed at not later than 19 years of age, when the works must be entered, and the scientific education carried further by private study, or by such other means as do not interfere with the practical work of their callings. Many colleges of the class to which we have referred have already arranged their courses to meet these requirements, and some of them, as will appear from our reports of visits, have workshops for the purpose of familiarising the students with the use of machine and hand tools."

Of course Sir Henry Roscoe in his address to the Manchester Section (*loc. cit.*) referred to our course of instruction in Chemical Technology in the Owens College in the examples given, and as it is in this course that my experience is mainly wrapped up, I may perhaps be excused if I refer to some details in connection therewith, which may be of interest and, peradventure, possess some points of novelty.

Although in many respects similar to, and to some extent planned from, the Polytechnikum course followed in Zürich, which curriculum I became familiar with after working there for three years as a teacher as well as a learner, an entirely new departure has been taken in our case having no parallel anywhere that I know of. This is, as I will as briefly as possible try to show, in the intimate and most advantageous connection established between the science degree course of the Victoria University and the course of Technological Chemistry.

It is possible for a student to set out for a four years' study at the Owens College, to make the preliminary course preceding matriculation in the University identical with and cover the preparatory

year for the Technological Chemistry course, and at the end of the succeeding three years to conclude by passing the B.Sc. degree of the Victoria University with honours in Chemical Technology, and also to acquire the certificate (analogous to the Zürich Polytechnikum Diplom) in Chemical Technology. The advantages, to such a student are manifest. He leaves the college armed with the requisite knowledge for starting in life, either in the profession of teaching or in the technical direction, and he has credentials to smooth his way, and to help in opening up whichever path he may choose. If in addition to this the student could take the certificate of the City and Guilds of London Institute, that would be still further proof of fitness. But this requires time, and so did apprenticeships in older times—apprenticeships of seven years for learning a trade. Now let us see what the Owens College course in Chemical Technology involves, and mainly consists of. We have the *Preparatory course*, analogous to the Zürich Vorkurs in which no technology at all appears, for we assume that if we mean by Chemical Technology, Applied Chemistry, then there must be first present the *something to apply* before we can talk of its applications. Hence this first year is devoted to the Study of Inorganic Chemistry (the non-metals), Practical Chemistry (qualitative analytical work in the laboratory, with Analytical Chemistry lectures), Mathematics, Mechanics (lectures), Geology (stratigraphical), French or German, Geometrical Drawing lectures, Mechanical Drawing, practical.

In the *second year*, or *first of the Technological Course proper*, we have Chemistry lectures (non-metals and metals, or junior and senior), Chemical Laboratory (quantitative work), Technological Chemistry lectures (first course). Experimental Physics or Elementary Mineralogy, German or French, with the injunction that it is desirable the student by the end of the second year should have gained a knowledge of the elements of both these languages. Then come Geometrical and Mechanical Drawing lectures and practise, as in the previous year.

In the *third year*, the *second of the Technological Course*, the Senior Chemistry lectures are repeated, if desired. The Organic Chemistry lectures are now entered, with those on Chemical Philosophy. Moreover, as a practical course, the Physical Laboratory is also entered where the practical study of Chemical Physics is pursued, or as a matter of choice the Advanced Mineralogy lectures with a practical course in that branch may be entered. Mechanical Drawing is continued, but now without the Geometrical Drawing lectures, and it is continued to the end of the entire course, so important is it considered that this part of an engineer's training shall be undergone by the students of Applied Chemistry. The second course of lectures in Chemical Technology is lastly to be heard and to be passed.

The final year is devoted to the hearing and passing the lectures and examinations in Organic Chemistry a second time, unless they have been heard and passed in the former year. The Technological Chemistry lectures, two courses—viz., the third and fourth. Chemical Laboratory, four days per week, and Mechanical Drawing. But now you may desire to know what the Technological Chemistry lectures themselves treat of, and how they are graduated to the increasing proficiency in general scientific, specially chemical, knowledge of the student, moreover, what is done in the Chemical Laboratory? We saw that in the *First Year's Technological Course*, the Inorganic Chemistry lectures had already been heard, and now we have a course of applied Inorganic Chemistry, that of the sulphuric acid and alkali manufacture with the attendant branches, as much as there is time for. It should be stated that these courses are ended by visits to chemical works as far as possible, so that practical illustration of the principles involved in the courses of lectures are thus afforded. In this direction we number amongst our friends of the Liverpool Section, several, who give us annually most generous assistance by throwing open their works to our students, and who generally themselves explain the principles of their plant and processes to them.

In the second Technological Year, Organic Chemistry is just commenced, and some insight has already been obtained into it, in the closing lectures of the Senior Systematic course, and moreover the elements of Chemical Physics have also been learned, and now comes a branch of applied Chemical Physics with elementary Organic Chemistry, in the Technological Chemistry lectures, which are heard in this year. A. The destructive distillation of wood and the products obtained. B. The Chemical Technology of fuel, manufacture of coke with recovery of volatile products in coke ovens. C. The distillation of coal-tar, and separation of crude tar products, and ammonia and ammonium salts from gas-liquor.

In the third and final year a further demand is made upon the knowledge of Organic Chemistry, which should now be attained, in the third course of Technological lectures, on the manufacture of coal-tar products, intermediate derivatives and coal-tar dyes and colouring matters; and in the fourth course of lectures, both the knowledge of Organic Chemistry and that of Geometrical and Mechanical Drawing will appear in their full value, in the study of textile fibres, bleaching, dyeing and calico-printing.

As regards the laboratory courses, what is first insisted on is the mastery of systematic courses of qualitative and quantitative chemical analysis, and this before any serious attempt is made in the direction of preparations further than those afterwards employed for analysis. Now it will be said by some, a course of good preparations, or of experimental investigation into the working of fundamental chemical and physical laws, would be of more real service to a student who is to be a thinker, and an original thinker, than all these disciplinary courses of analytical work, already so "cut and dried," and tabulated. I would reply, "there is a time for everything," and after this course of manipulative analytical study is over, is the right time to commence to utilise all the means now acquired and at hand, for original research and investigation, either by means of preparations or original work.

But now to come to one of the difficulties with which such a high standard and course in England is encompassed; this is that its necessity is not sufficiently understood, and yet, so far as I have observed, all those who *have* persevered and *have* passed our full course, are now in good positions, positions proportionately higher to their superior merit.

There is no outlay of proportionately meagre amounts in any commercial branch, for which such, I would almost say, outrageously large and quick returns are demanded, as in Chemical Education in this country.

There is another difficulty, as regards getting admittance for the higher talent of our lower classes into the higher colleges.

However, we are looking forwards hopefully to lay the foundation of a grand system, and the outlook is a satisfactory one, but would be more so if we could only by means of bursaries or scholarships connect the board schools and the higher colleges. When such connection is effected, I should not be surprised to find that in the future, looking at the thoroughness of the teaching given, the managers and even heads of our industrial

concerns will be rather supplied from the chosen spirits of board schools. than from the sons of the wealthier classes who have been sent to Eton and Harrow, etc.

In conclusion, it is pretty clear that the meaning of the word Chemical Technology receives often different interpretations, but the sense in which I have wished to use it and understand it, is to refer to the scientific principles involved in and encompassing the chemical industries, and in the use of means and appliances therein. I know it is nonsense to attempt to teach Chemical Technology, in the narrower sense, in colleges, but there is much that can be taught as already shown, and if the governing principles are taught by those who have lived and served in the factories, more vivid and true pictures and illustrations can be given, and the applications of the principles themselves better amplified and enforced. Nevertheless, so far as my own teaching is concerned, and especially in the branches in which I have had practical experience, it is certainly not behind the times. To be ten years behind, except in certain special branches, limited in number, would argue practical inexperience or negligence, or at all events that our Journal was not serving its purpose in educational directions. I quite agree that the technical text-books are mostly ten years behind, and often more. However, in teaching what I understand by Chemical Technology, it is not necessary to give all that is done absolutely up to date, nor to give full instruction in all that is done. The student's time is far too precious for the latter and too much occupied by the study of broad scientific truths; but the teachers would, or ought to, know how best to give the general outlines, and draw general lessons of scientific principle from what they have seen and know, so that the clothing with more minute practical details, proportions, and quantities would soon be put on hereafter, when the arena of actual working practice is entered. The mental training in generalising legitimately and logically from the smaller area of the laboratory to the larger spheres of working on a larger scale, if it be but by outline and on broad principles, properly carried out, is, I am certain, of the highest value to the student, in furnishing him with general maxims and data to help in clearing his way, assisting his vision and reasoning faculties, and giving him a readiness more quickly to adapt himself at the outset, on entering the works, to the new circumstances and scenes about him. This means, of course, to begin to be of real use to his employers in the shortest possible time after entering their service.

To turn finally to another point which has been mooted. Before the Society of Chemical Industry undertakes to *do something* to promote *sound instruction and examinations in chemical technology*, I should like to hear precise definitions of what these are to mean. Our Society, I take it, is doing pretty well in issuing an annual report of the advance of Chemical Technology in the shape of the Journal, which costs many of the members both of our council and the publication committee no little trouble and time. Our Journal is an ever progressing and progressive course of Chemical Technology itself, and both as a standard of the knowledge required, and as a means of instruction, it aims at doing a grand work, in which all its sections and each individual may participate.

DISCUSSION.

The CHAIRMAN was sure they were all very much indebted to Mr. Watson Smith for his admirable paper, and for bringing the whole subject so ably before them.

Mr. HENRY BRUNNER: It seems to me that this question of scientific and technical education is a very large one, more especially as for every different part of our country the system of teaching, and certainly the direction of that teaching, cannot be the same. I think that science, even the most elementary, to be properly taught, ought to be taught by scientific men, and I object very much to this additional work being put upon teachers, such as school board teachers, because they have, as a rule, already too many subjects to teach, and to expect them to take science in addition would be a great mistake. With regard to what Mr. Watson Smith has said about The Victoria University and The Owens College, I am of opinion that they begin too young. A four years' course is very good, and ought to be ample if a student is sufficiently well prepared when he comes there to profit by it, but boys are admitted to the college, and they may commence this four years' course at fourteen years of age. I think that is two years too soon, and that they ought not to be admitted before they are sixteen years of age, because I do not think it possible for boys to take proper advantage of a comparatively severe course of scientific teaching at a time of life when their physical development requires so much care and attention. It seems to me we want something intermediate between our elementary schools and our scientific and technical schools such as The Owens College. What these schools are to be I do not know,* and from what little I have seen of the Blue Book containing the Report of the Royal Commission, there does not appear to be any suggestion for provision of schools of the kind, but it appears to be contemplated that boys should go from board schools—by which I understand elementary schools to be meant—to scientific and technical schools, and thence, perhaps, pass on to the universities. I want again to say that we are too anxious—or appear to be too anxious—to turn our young fellows of scientific and technical training out into the world too soon. When a young man has finished a course such as that provided by the Owens College, he ought to be able at once to take up in a manufactory or works a position where his knowledge would be of use to himself and to his employers. But at eighteen years of age he could not be put in charge of workmen simply on account of his youth. They would not listen to him. If a student finished his course at twenty or twenty-one it would be quite early enough.

Mr. CAREY: I quite agree with what my friend Mr. Brunner has been saying as to the age of the boys when they begin this technical education. It is too early to take them immediately from the schools, and to, for instance, The Owens College, without distinguishing as to the class in which these boys are, and the future place they are to fill. We have to observe the distinctions which Mr. Watson Smith has spoken of, and which are also spoken of in the Report of the Commissioners—that is, the "workman and foreman" class, and the "manager and employer" class. It is quite obvious that there would be a very much wider education given in the latter case than could be possibly finished by a boy of 16 or 17 years of age. I think the remarks of the Commissioners on page 516, vol. i., bear out what Mr. Brunner has been saying. They say:—

"The best preparation for technical study is a good modern secondary school of the types of the Manchester Grammar School, the Bedford Modern School, etc. We consider it to be essential that steps should be taken to ensure that this work shall be carried on with greater vigour in the future than it has been hitherto. In the schemes for the new schools,

* But I trust the necessity of physical training will not be so completely overlooked as it has been in our elementary school system.

the subjects of science and modern languages should form a very prominent part. But the existing endowments are unevenly distributed. In many of the large manufacturing centres no resources of the kind exist. Private enterprise is clearly inadequate to do all that is required in establishing such schools, and we must look to some public measure to supply this—the greatest defect of our educational system," etc., etc.

Referring to the subject generally, I would like to say that, with regard to Mr. Tate's paper, I do not agree with all his remarks. I think Mr. Tate proposes, if I understand him rightly, that we should give a detailed technical education to workmen, and to tell them, for instance, how to work furnaces, an education which can only be carried out, I think, satisfactorily in the works. With regard to the preparation for technical work, I agreed with Mr. Mond at the last meeting, when he said something to the effect that we should arrange matters so as to give a student a thorough scientific education, educating his faculties and then leaving the detailed technical work to the time when he gets into actual practical work in the factories. I think you cannot give a young man too wide an education, or one too thorough in actual science, but of course the direction which his scientific studies take must be with a view to the future, and the branch of technology he intends to pursue. I think it might be useful for us, as another text for our discussion, if we took the recommendations of the Royal Commission, and what they suggest should be done in the way of altering our present legislation for the purpose of improving technical education. I do not know whether it would be in order, sir, to discuss these recommendations one by one, to see if we can come to any action upon them, and whether we as a section are inclined to support them, or whether we have any suggestions to make in addition to the recommendations of the Commissioners, both with regard to elementary schools, and with regard to the higher education also. I do not know whether it would be in order now.

The CHAIRMAN: It is in order; and the only question is whether we should come to a definite resolution on the subject, from this Section. I do not know whether it would not be desirable, after discussing the question, that we should not possibly pass some resolution, because I presume if that were forwarded to the proper quarter, it would be some support to the recommendations of the Commission.

Mr. CAREY then proceeded to read as follows:—

On page 517, vol. i., the Commissioners say:—

"For the great mass of our working population who must necessarily begin to earn their livelihood at an early age, and from whom our foremen will be mostly selected, it is essential that instruction in the rudiments of the sciences bearing upon industry should form a part of the curriculum of the elementary schools."

On page 536 *et seq.* of the same volume, appear the general recommendations of the Commissioners, many of which appear to me to be of great importance—*e.g.*:—

"I. As to public elementary schools.—(*a*) That rudimentary drawing be incorporated with writing as a single elementary subject, and that instruction in elementary drawing be continued throughout the standards, etc. (*b*) That there be only two class subjects instead of three in the lower division of elementary schools, and that the object lessons for teaching elementary science shall include the subject of geography.

"II. (*a*) That School Boards have power to establish, conduct, and contribute to the maintenance of classes for young persons and adults (being artisans) under the Science and Art Department. That in localities having no School Board the local authority have analogous powers . . . .

"V. (*a*) That ratepayers have power by vote to sanction the increase of the expenditure, under the Public Libraries Acts, beyond its present limit, and that the restriction of the Acts to localities having 5000 inhabitants and upwards be repealed."

In addition to the recommendations which necessitate action on the part of the legislature, or of the public authorities, there are suggestions made for the consideration of those in whose power it is to comply with them, such as:—

"I. That it be a condition by employers of young persons, and by the trade organisations, in the case of industries for which an aquaintance with science or art is desirable, that such young persons requiring it receive instruction therein, either in schools attached to works or groups of works, or in such classes as may be available; the employers and trade organisation, in the latter case, contributing to the maintenance of such classes."

The recommendations which I have read—and they are only examples of many others of equal interest and importance made by the Commissioners—appear to me to give subject matter for serious consideration and discussion, and to be in the main recommendations which should be supported by our Society.

Mr. A. NORMAN TATE said that in opening the discussion at the November meeting, his object was more especially to call attention to the matter, with the view of moving a resolution that that Section should ask the Council to appoint a permanent committee, to take cognisance of what was now being done in this country to further instruction and examination in chemical technology, and to suggest from time to time improvements; and he thought the remarks that had been made that evening, especially those which had fallen from Mr. Carey, showed that such a course of procedure was desirable. He thought he might have been a little misunderstood in the remarks he had made at the November meeting. He certainly did not think it was possible by any systematic course of instruction in schools or colleges to teach workmen or foremen, employers or superintendents of works, all the technical details of any manufacture in which these persons might be engaged, but he did think they might go much further than at present in giving the power to carry on technical work. What was required first of all was a knowledge of facts, and he thought it was desirable to supplement the mere lecture instruction by a course which would bring out the power of observation to a greater degree. Mr. Watson Smith had spoken of the work done by the several instructors in the Liverpool, Manchester, and other Board Schools. He (Mr. Tate) had on two or three occasions had the pleasure of watching Mr. Hewitt, Chief Science Instructor to the Liverpool School Board, in his work of instruction in mechanics, and he put the elder boys through a course of instruction which could not fail to give them powers of observation which they could never have imparted to them by the study of the ordinary subjects of board school instruction. A boy after passing through such a course, if he went into a shipbuilding yard, a builder's yard, or workshop, would have implanted in his mind a knowledge of the principles of much of the work he would have afterwards to carry on. This was the sort of thing that they wanted carried on to a greater extent. Although this work was done in Liverpool, in Manchester, and in Birmingham, if they took other towns where there was a large number of workmen engaged in trades and manufacturing operations, they would find that the lads there left school and went into these manufactories without any such training. If a committee were appointed, one thing that could be done would be to issue recommendations to school boards in towns in which chemical industries were carried on, and point out what was done in other places, and keep them well informed of what was really useful in special technological directions. Then when they came to special studies, he noticed in the Blue Book a very excellent plan of training adopted in certain schools on the Continent. The elder pupils

were occupied some portion of each day in taking meteorological observations. Certain of them were set apart to take the temperature and barometrical pressure, etc., registering these in a careful manner. Now here pupils were trained in powers of observation, and what observations they made could be readily checked. This was one way in which the observing powers might be trained; and there were many others involving the working of simple processes only. A youth going into a chemical works, already trained to take temperature, specific gravity, etc., would often be more useful than the lads who now commence work in chemical manufactories and other industrial establishments. Another point to which he would call attention was, how far it might be desirable to introduce into this country, special schools, something similar to the apprentice schools that are in existence on the Continent. In vol. i. page 48, of the Commissioners' Report, there was a description given of these technical apprenticeship schools. There was much to be said in favour of such schools, either as taking the place of some of the apprenticeships which were in vogue in this country, or in supplementing them. In many of the technological colleges there was a want of grouping, especially in relation to chemical technology. It was all very well to give a student a knowledge of the general facts of chemistry, and of chemical analysis and power to make chemical analyses, and do other laboratory work; but there was wanted something more than chemical instruction, before chemistry could be made available for technological purposes. The student must have a knowledge of subsidiary subjects. How was it that so many of their chemical patents fell through? It was simply through a want of knowledge of the composition of the materials used in carrying out chemical operations and methods of putting them together. Therefore in addition to the knowledge of chemistry it should be insisted upon as a matter of chemical technology, that there should be a thorough knowledge of the building and other materials used, their quality and strength, and the manner in which they could be best utilised for certain purposes. Then again they should have a knowledge of mechanics and machinery. The most elaborate machinery might be designed and yet break down in chemical operations. He therefore could not look upon any course of instruction of chemical technology as complete, unless the student was compelled to study these subsidiary matters to a considerable extent of detail. He did not think that it was altogether impossible, in addition to ordinary laboratory work, that instruction in working experimental furnaces and other larger apparatus used in manufactories, might be given in good technical schools, and certain processes taught, such as, for example, modes of using to best advantage fuel, etc. Industrial museums would, he thought, prove highly useful, and it was to be hoped that the exhibition of inventions, etc., which was to take place next year in London would give them a considerable amount of information. They might do something towards establishing, in the centres of industry, technical museums. A technical museum, in a town like Widnes, would have a very good effect. It would show those who were growing up to enter the works what the substances used and products were that were manufactured in the town, and give them some idea of the general processes by which they were manufactured, and similar museums might be established throughout the country. It had been suggested that in Liverpool there should be a museum of casts; but at a meeting he had attended, when several artisans were present, it was considered by them that the money would be far better spent in a museum of mechanical inventions and contrivances, and the different kinds of woods and metals used in workshops. The remarks made at the meeting he referred to showed that workmen were quite ready to make use of exhibitions of machinery and industrial appliances, and learn from them as much as possible. He therefore thought that museums of raw materials used in chemical processes, and their products, with illustrations of machinery and apparatus used, would do much to further chemical technology. Then as regards prizes and scholarships, it might not be within the power, at present, of the Council to vote funds for special prizes, etc.; but something might be done, he thought, with good results, in offering prizes for special proficiency in chemical technology—something after the manner of the City and Guilds of London Institute. This Institute offers prizes of from £1 to £5, with medals, etc., for proficiency in certain subjects. On the same principle it might be possible to establish scholarships. He considered that examinations in technology were too much upon paper; and they ought to have some better test of the knowledge of scientific facts and certain general details. He thought the best examinations would be in seeing candidates while at work, either in firing a furnace or working black-ash, or testing the work in making some textile fabric, and other really practical operations. Let the examinations be an actual test of the work done, and not the putting of certain printed questions to be answered on paper. He was still prepared to move that a committee be appointed to take cognisance of these matters.

The Chairman expressed a hope that some such a resolution as Mr. Tate had suggested would be passed. That Society might undoubtedly give support to any legislation that might be proposed for the improvement of technical education, and he thought Mr. Carey was quite right in considering the recommendations which the Commissioners had made. It was clear that the instruction given to workmen must be very different to that given to foremen and managers of works; but he thought it was very desirable that every workman engaged in chemical manufacture should understand something of chemistry, and some idea of the substances they were treating, and the behaviour of those substances, and the general laws which governed each. A stoker was all the better for knowing something of the laws of combustion. He did not see why elementary chemistry should not be taught in board schools, but he quite agreed with Mr. Brunner that science should not be taught by the ordinary school teachers. If they taught science at all, it ought to be taught in a proper manner. He thought the system adopted in Liverpool was a proper system, and he did not see why they should not have some such system at Widnes. The Royal Commission recommended that in rural schools instruction should be given in the principles of agriculture in the upper standards. He thought a similar thing should be done in a place like Widnes, and lessons given in the principles of chemistry, and so with other districts. But then they must go to something beyond mere elementary instruction. He thought it desirable to have the full course of instruction such as was given at The Owens College, where, so far as he had gathered, there was a most admirable curriculum. He agreed with Mr. Brunner that it would be far better for boys to enter such a college at the age of 16 and leave at 20, than to go at 14 and leave at 18. This curriculum had been in existence only four years, and he had not the slightest doubt after some years they would be able to improve upon the curriculum, but as far as it had gone it seemed to be a very efficient one. He was glad to hear Mr. Watson Smith quote from Sir Henry Roscoe, that after being taught

analysis and chemical preparations, pupils should devote themselves to some kind of original research. This was most valuable. It would draw forth their powers of observation, and it would be the most useful part of their education to fit them to take part in chemical works. He was glad that Sir Henry Roscoe had come to the same conclusion as he had himself, and made the same recommendation. Nothing as yet had been done by the Government upon the Report of the Royal Commission, but he thought it would be very desirable and of great advantage if a society like that, as well as the Iron and Steel Institute and other societies, should press upon the Government the absolute necessity of taking steps to follow the Commissioners' recommendations.

REPLY.

Mr. Watson Smith: I entirely agree with Mr. Brunner's sentiments with regard to the advantage of the educational system of the board schools in different cities and towns, differing and varying as to degree or bias, both as regards kind and amount taught of the elements of Applied Science according to the nature of the staple industries of the cities and towns in question.

It is certainly desirable that mere boys should not enter the higher colleges too young, and in an unprepared state; their parents and guardians are sometimes too eager to send them early to college in order to take them away again too soon. I quite agree with the statement that they ought to go later, if that means *better prepared*, and stay longer, if that means *completing the educational course*, but I would like to add a word here: there are not a few who come not too young, but they come unprepared; *unschooled*, in fact. If such as these stay until old age advances they would scarce be able to recover what has never been gained at school. What I see great cause to complain of, is that amongst certain of our middle classes the question of the really sound, solid education of boyhood and youth in the schools, according to some rational plan, is not treated with sufficient earnestness. If something of the vigour, zeal and determination of purpose manifested in the various popular school games and sports, were *insisted on* in the mastery of even the lower elements of mathematics for those who are to study science afterwards in our colleges, then we should see fewer examples of young men utterly unable to rise in science, because almost incompetent to reason numerically, not to speak of mathematically. It is usually a grand blunder to assume or suppose—as I fear is often assumed or supposed—that an unschooled boy can make up his deficiencies at college; *as a rule, he cannot;* there are exceptions, *but they are few*. This blunder is one that is being continually made in this country; and it is the source of much perplexity to the teaching bodies of our higher colleges, much despair and disappointment when it is well-nigh too late to mend, to the student and his friends, *and of most of the failure of the young chemists of this country to compete with those of Germany*. Nearly all the energies and time of the teachers are consumed in teaching unfledged birds to fly, as it were; so that strength, time and opportunity are shortened for the very few capable of soaring aloft. This too usual and general state of things explains, moreover, a point very properly called attention to by Mr. Carey, viz., that it should not be possible for board school boys, in a general way, to enter at all easily, and compete, in the courses of the higher colleges. In these colleges we have not, as in Germany, in the main to deal with our subjects, starting from a certain higher platform; but we have to cope with the drawbacks and disadvantages already prefigured, as far as we are able, by exercises, tutorialising, and the like. As an example may be mentioned what has already been openly styled, "chemical arithmetic," the great need of which is manifested in the numerous excellent little books published on the subject, which points—not so much to the difficulty of elucidating the chemical theories or the chemistry of certain experimental operations—as it does to an evident flaw in the previous systems of elementary mathematical instruction in the schools. Why, else, is it that such little books are never to be seen in Germany and Switzerland in connection with the universities and polytechnic schools? Our board school boys are taught to perform most of such calculations (at least in Manchester) with considerable ease, both in the branches of mechanics and chemistry. However, I believe I referred to *the chosen spirits of the board schools*; and since our lower class population is so vast, these "chosen spirits" may, peradventure, represent a respectable number. At The Owens College we have one small scholarship available in chemistry—viz., the "Crace-Calvert Scholarship," and only that one, and this available but once in two years. This is at the present moment held by a former board school scholar; and I am bound to say he is by far the best man of his year. With regard to Mr. Tate's motion in its *present* form, it seems to me both a practical and a good one; and I believe the reports furnished by such a committee would be valuable in a variety of ways. The technical practice Mr. Tate describes—in work likely to be of future value to ship-builders and similar workpeople—would be very well for Liverpool lads, just the thing for Liverpool, but the bias in Manchester must be in another direction—viz., that of chemistry, for in Manchester we have cotton bleaching, cotton dyeing, calico printing, and general chemical manufacturing, as our staple industries. However, I think I now see what one of Mr. Tate's objections to the City and Guilds of London Institute programme refers to,—viz., the lack of laboratory trials and examinations in connection with the questions set. It must be remembered though, that these examinations of the City and Guilds of London are thrown open free of cost to the country; and laboratory or workshop testing would entail vast expenses. Besides, if the theoretical side of the question is so grasped as to enable the candidates to pass these examinations, we need not complain; there is a lifetime to follow for utilising the theory in practice. With regard to the matter of what is termed "grouping;" this is done as I have already described in my paper; but it is done in subservience, as I hold it should be, with the student at college, to the main thing,—viz., the grounding and foundation in scientific principles. I believe the subject of strength of materials, and so on, is touched upon in the Geometrical Drawing lectures in our College; and as regards the further one of the chemical technology of building materials, mortars and cements, etc., this would be all very good for the practical engineer. However, our course of Chemical Technology in The Owens College is growing yet, and we have youth on our side, for our course was but founded in 1881. As to testing by examinations in technology taken in the narrower sense, such, *e.g.*, as examining a man on soda making, and then setting him to make a black-ash ball, and watching him do it, there I differ with Mr. Tate. Where the examination elicits evidence of general grasp and knowledge of scientific principles, there I follow; but where the mere manipulative skill, or the more specialised details, besides conscientious working and moral principle, are concerned, there I am sure we cannot intrude. As regards alkali making, moreover, in which there are no special secrets, even such manipu-

lative competitions might be conceived possible; but take another branch, that of dyeing, or of the manufacture of dyes and colours, and there, I imagine, there would be a difficulty, for no dye house or dye and colour factory, that I know of, would permit such a thing; and for a workman to enter into such competition would be regarded probably with sufficient suspicion by his employers as to secure for him the wide world to hunt in for a new post in which to exert his prowess. In answer to remarks by Mr. Alex. Watt, I do certainly consider that there is scientific principle involved in the making or manufacturing with certain regard to economics, and as both logic and political economy are scientific branches, so the economics of the manufacturing industries admit of scientific treatment. Such treatment is absolutely necessary, and I do not overlook its principles, by any means, in my teaching. Without bestowing some attention to these, how could one else elucidate the mysteries of the occasional practical reversal of the terms "chief products" and "by-products." In science, the key-note is, so to say, "truth for its own sake;" in technology, it modulates into "truth for the largest amount of tangible profit it can be made to yield." I fear that if the group of possible technical subjects were swelled by too many reinforcements, then chemical technology, as a study, would rise from being the handmaid of science for the student, to the position of the tyrant; and the grasp of scientific truths, and the march in the right path of acquirement of fundamental truth and laws, would be weakened and hindered by excess of technicalities, which could all be gained and learned in the life and practice of the future, when, however, the time for studying and learning scientific principles has fled. I think I read in the extract from the Report of the Royal Commissioners that the teaching of science in the board schools is not mainly delegated to the board school teachers; it is not so in Liverpool, Manchester or Birmingham; but these teachers hear the teaching of the chief instructor, and then help the pupils, in what they, as older and more experienced persons, have learnt and understood to better purpose than the children, their pupils have.

I am not sure if stress has been laid by the Royal Commissioners on the technological bias, if I may use the term, to be observed in different industrial districts; but from their report it is clear that this has followed as a natural consequence in Liverpool, Manchester and Birmingham. No doubt such data as these could be usefully collected and applied by a committee appointed by our Council, such as that proposed and under consideration.

It was then moved by Mr. TATE: "That this Section recommend the Council to appoint a Committee for the purpose of considering the subject of Technical Instruction, and taking such steps as may be deemed advisable to promote more of such instruction in this country, especially as applied to Chemical Industry."

Mr. CAREY seconded, and the motion was carried unanimously.

Manchester Section.

Chairman: Sir H. E. Roscoe.

Vice-Chairman: D. B. Hewitt.

Committee:

R. F. Carpenter.	J. Knowles.
C. Estcourt.	I. Levinstein.
H. Grimshaw.	C. Schorlemmer.
Peter Hart.	Watson Smith.
J. von Hohenhausen.	Wm. Thomson.
T. Jackson.	D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, January 20, 1885.

DR. HEWITT IN THE CHAIR.

THE CHAIRMAN: Words fail to express the feelings of all who have been placed in a similar position to that which Sir Henry and Lady Roscoe have so recently been called upon to endure, in the very sudden decease of one in whom their hopes were centred; and as I am sure there are many present who have realised those feelings, it will not require any lengthy explanation on my part in asking you to pass a vote of sincere condolence and sympathy with Sir Henry and his family, in the loss which they have sustained in the death of their son. I had not the pleasure of knowing Sir Henry's son, but I am informed that he promised to attain distinction in a somewhat different sphere from that in which his eminent father has become so well known, and that he has been cut off in the springtime of life and promise, adds bitterness to this deep bereavement. I will, without further comment, move the following resolution:—"This meeting desires to express sincere condolence and sympathy with Sir Henry and Lady Roscoe and their family in the sad bereavement they have sustained in the loss of an only son and brother."

Mr WM. THOMSON, in seconding the vote of condolence, said: After attending the meeting of the British Association a few months ago in Canada, I saw Sir Henry's son at the Falls of Niagara, when he seemed to be in the enjoyment of robust health, and of the wonderful Falls, in the vicinity of which he remained during several days. I understand it was not his intention to follow in the footsteps of his father as a man of science, but in another direction he had already shown marked ability in a series of very cleverly written articles which appeared during last autumn in one of our Manchester newspapers, entitled, "Jottings from America," and which many of us must have read with pleasure. The loss which Sir Henry and Lady Roscoe have sustained by the untimely death of their only son, when he was about to enter on a career of the highest promise, is one with which we must all deeply sympathise.

The CHAIRMAN called attention to the "Rivers Pollution Bill" which had been introduced into Parliament, and which has come before the London Section, and said: It is hoped that the members of the Manchester Section will prepare themselves by obtaining all the information they can that will throw any light upon the matter, so that it may be fully discussed. It is a matter which will affect every manufacturer, and although of a practical nature, it is a subject upon which scientific knowledge must be brought to bear. I think it is the intention of the Committee to put it upon the notice paper for the next meeting, and any facts that can be adduced will be of the utmost importance. There is no doubt that this Society, consisting as it does of practical men, will have to make in its joint capacity some important reports to the Government on the matter. I need not say that any one who wants information upon the subject can find it in the voluminous reports which have been made to Parliament in former years. Some of the proposed tests of purity which were brought before the Rivers Pollution Commission on former occasions, and which proved to be impracticable, are again being introduced just as if no inquiry had been made. I hope that all who can will make some contribution to the subject, not merely for the sake of opposition, but for the purpose of showing whether it

is possible, without interfering with trade or manufacture, to render our rivers more sightly and purer than they are at present.

Dr. Bott's Paper on "Hempel's Methods of Gas Analysis," and Prof. Wanklyn's Communication will appear in the March number.

Newcastle Section.

Chairman: J. C. Stevenson, M.P.
Vice-Chairman: B. S. Proctor.
Auditor: N. H. Martin.
Committee:

P. P. Bedson,	John Pattinson.
G. T. France.	H. R. Procter.
C. H. Gimingham.	W. W. Proctor.
John Glover.	J. F. Stark.
A. S. Herschel,	T. W. Stuart.
John Morrison.	

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Next meeting, March 5.—1. On the Proposed Statue to Nicholas Leblanc; 2. On the Recovery of Sulphur from Alkali Waste; 3. On a Furnace for Chemical Operations which is neither an Open Furnace nor a Close Furnace; and 4. On the Manufacture of Chlorine from Oxychloride of Magnesium. By Walter Weldon, F.R.S.

Meeting held, February 12, 1885, in the Lecture Theatre of the Durham College of Science.

MR. B. S. PROCTOR IN THE CHAIR

DISCUSSION ON THE NOTES READ AT LAST MEETING.

Mr. Morrison wished Dr. Lunge had stated the size of the pieces of metal operated on in studying the action of chlorates on them, and how their surface was determined. In multiplying the results to the actual size of the evaporating pans, any error would of course be greatly increased.

Mr. Tatters expressed his agreement with what Mr. Morrison had said.

Mr. Stuart thought that Dr. Lunge's well-known accuracy and skill might be relied on to avoid error wherever it was possible. It was, however, very difficult to imitate exactly the conditions of manufacturing operations in laboratory experiments. As a matter of fact, it was known that the pans suffered very little in practice.

Dr. Smith mentioned that in some very similar experiments which he had conducted in Dr. Lunge's laboratory, pieces of metal were used exposing a surface of about 20 square cm., and were accurately measured by a skilled mechanic.

DISCUSSION ON THE "RIVERS POLLUTION BILL."

The Chairman, in introducing the matter, regretted the unavoidable absence of the Chairman of the section, who would have spoken with authority on the matter. He called attention to Clause 26, and to the penalty in Clause 3, which he said applied to every household drain; and also to the loose wording of Clause 9, which made it appear that to escape prosecution under the Act, liquids must contain more than the quantities of the various contaminations mentioned. These were evidences of want of care in drawing up the Bill, and in dealing with a subject of so great importance, the greatest care was necessary. He then called on

Mr. John Pattinson, who said: The "Rivers Pollution Bill," which will probably be introduced into Parliament during the next session, and which we are called upon to discuss this evening, is a measure intended to supersede the Rivers Pollution Act of 1876, which has been comparatively a dead letter since its enactment. The present Bill is intended to remedy some of the defects of the 1876 Act as to methods of procedure, and also as to the definition of what in certain cases constitutes an offence under the Act. These defects have been described by Mr. C. N. Cresswell, in opening the discussion on this subject at the meeting of the London Section of this Society on the 5th of January last. Divested as far as possible of its legal verbiage, the scope and aim of the proposed Act appear to be as follows: In Clause 2 are defined what are to be considered as offences against the Act. In the first place it is an offence to put into a stream any solid matter so as to interfere with the due flow of the stream or alter its bed or pollute its waters, or to put in any solid matter which is putrid, poisonous, offensive or injurious to animal life. Secondly, it is an offence to put liquid or solid sewage matter into any stream: and thirdly, it is an offence to put into any stream any liquid containing matter poisonous, noxious, polluting, or injurious to animal life. In Clause 9 the Bill defines the term "stream" to mean that it "includes all rivers, whether tidal or otherwise, brooks, navigable canals, lakes and watercourses, except such parts of a tidal river as the Local Government Board may by order, published in the *London Gazette*, after local inquiry, determine on sanitary grounds not to be part of a river. It shall also include so much of the sea as the Local Government Board may by like order, and on the like ground, declare to be part of a stream." Having defined the offences under the Bill, it provides in Clause 5 that on the complaint of any conservancy authority or fishing board of the district, or of any occupier of land or a dwelling-house within the district, the sanitary authority of the district shall institute proceedings to restrain the commission of offences against the Act. If the sanitary authority refuses to institute such proceedings, or does not prosecute them with due diligence, the complainers may apply to the county court of the district for leave to institute proceedings themselves, and to prosecute them at the cost of the sanitary authority. Proceedings may also be instituted by any person who may consider himself aggrieved by the commission of offences against the Act. In the latter case it is provided that the Court may order the person who institutes the proceedings to give security for the costs of such proceedings. Persons of the latter class are further encouraged to institute proceedings against alleged offenders by clause 3, which provides that the offender "shall pay to the person complaining, or to such other person as the court may direct, such sum not exceeding fifty pounds a day for every day during which he is in default as the court may order." In case of proceedings being instituted for any alleged offence against the Act, Clause 3 provides that the county court may by summary order require any person to abstain from the commission of such offence, and "may direct any skilled persons to report as to the best means to be adopted for preventing any pollution, and may make the adoption of such means by the person who has committed the offence part of its order: provided always that the court shall not sanction the adoption of any mode or means of action for prevention of pollution that does not reduce the polluting matter to a less extent than is defined by the standards of purity" given in Clause 9. It is not very clearly so stated in any part of the Bill, but I think the inference may be fairly drawn that no liquids of any kind are

to be allowed to be put into a stream which are less pure than the standards given in Clause 9. The standards of purity are those recommended by the late Royal Commission on the Pollution of Rivers. Some of these in my opinion are too lax and some are too rigid and exacting Clause 4 gives the right to either party in an action to appeal against the decision of the county court, and Clause 6 gives the right to apply to the Local Government Board for an extension of the time allowed for adopting methods for the remedying of pollution. Such is a brief description of the principal features of this Bill. It will be seen that it is a very sweeping and stringent measure, and that, if passed in its present condition, it is likely to press very seriously not only upon many manufacturers, but even upon householders of every class. According to Clause 8, every person who sends sewage matter through his house-drain into a sewer, and from thence into a stream would be infringing the Act, and would be liable to a penalty of fifty pounds, and ten pounds a day for every day he thus uses his drain, if it has been made since 1876, and if the stream is not such part of a tidal river as "the Local Government Board may determine on sanitary grounds not to be part of a river." Surely this is far too stringent a clause to be placed at present on our statute book. The inducements held out by the 3rd and 5th Clauses are likely to cause litigious and needy persons to commence harassing legal proceedings against manufacturers and others, and this seems to me to be an objectionable feature of the Bill. The proposed Bill, if passed, would press most disastrously on many owners of mines, and on many manufacturers. To comply with its requirements, owners of mines and collieries would have to provide, in many cases at great cost, subsidence tanks and subsidence reservoirs. To enforce such a measure in the present condition of mining and manufacturing would in many cases be tantamount to closing the mines or manufactories altogether. I have had much experience in the methods of dealing with the waste waters of paper works, and am well acquainted with the degree of purity which can be attained in these waters by the application of the best practicable means. I have no hesitation in saying that if the standard of purity given in Clause 9 *a* of this Bill were insisted upon in the case of these out-flow waters, and if the penalties were enforced, no paper mill could continue to exist. In many other cases there are slight and sometimes considerable discharges of comparatively innocuous matter from manufactories, in which it would be very difficult, if not impossible, to comply with the requirements of this Bill. A boiler could not even be sludged out direct into a stream without incurring the severe penalties of this proposed Bill. On the other hand, some of the standards of purity are far too lax. Standards *h* and *i* are of this character. To allow liquids possessing an acidity equal to that which is produced by adding two parts by weight of real muriatic acid to one thousand parts by weight of distilled water, or possessing an alkalinity equal to that produced by adding one part by weight of dry caustic soda to one thousand parts of distilled water, is to allow the admission of liquids which would cause certain and immediate death to all animals which might come within their influence. I have prepared solutions of hydrochloric acid and caustic soda of the prescribed strengths, and the members of the Section will have an opportunity of noticing how very much stronger these are than any liquids should be which are allowed to be run into a stream under most circumstances. The great fault of the Bill, in my opinion, is its rigid and unyielding character. It makes no allowance for the varying conditions of the towns, and the varying character of the manufactures, and the streams with which it has to deal. It appears to me that the courts which have to adjudicate on alleged cases of pollution should not be bound down by the rigid conditions and standards of purity of this Bill, but that they should have the power of dealing with each case on its merits, and of insisting upon the adoption of the best known practicable means of preventing pollution. It is incumbent on every one likely to be prejudicially affected by this proposed measure to endeavour to get it modified before it passes into law, and I think the various sections of the Society of Chemical Industry are acting wisely in calling attention to the matter. I beg to move the following resolution:—"That this meeting of the Newcastle Section of the Society of Chemical Industry, being of opinion that the proposed 'Rivers Pollution Bill' is inadequate to the objects of its promoters, and injurious to the interests of manufacturers, recommends its early consideration by the Council of the Society, with a view to such action on its part as the interests of Industrial Chemistry may require."

Mr. T. W. Stuart: I have great pleasure in seconding the resolution. The Bill will press very hardly on manufacturers and mine-owners. The standards of purity are such as in many instances cannot be worked up to.

Mr. John Morrison: What has struck me most is Mr. Crookes' proposal, mentioned by Mr. Cresswell, that each river should form its own standard of purity; that seems to me to be the best form the measure could take.

The resolution was then put to the meeting, and carried unanimously.

Birmingham and Midland Section.

Chairman: Alexander M. Chance.
Vice-Chairman: W. A. Tilden.
Committee:

G. S. Albright.	C. O'Sullivan.
Horace T. Brown.	L. Percival.
G. S. Casson.	R. Peyton.
J. F. Chance.	J. H. Player.
F. C. Clayton.	C. T. Ryder.
L. Demuth.	G. Shaw.
G. Gore.	W. Southall.
R. Heathfield.	W. A. Wiggin.

Hon. Treasurer: Charles Hunt.
Local Secretary:
A. Bostock Hill, 14, Temple Street, Birmingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Glasgow and West of Scotland Section.

Chairman: Ed. C. C. Stanford.
Vice-chairman: J. Ferguson.
Committee:

George Beilby.	E. J. Mills.
A. Crum Brown.	James Napier, jun.
T. Carnelley.	T. L. Patterson.
J. Christie.	J. B. Readman.
John Clark.	Edmund Ronalds.
W. Dittmar.	F. J. Rowan.
Geo. M'Roberts.	R. R. Tatlock.
Jas. Mactear.	William Wallace.

Hon. Treasurer:
J. J. Coleman, 45, West Nile Street, Glasgow.
Local Secretary:
G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the Meetings to be sent to the Local Secretary.

A Meeting of this Section will be held in the Rooms, 207, Bath Street, on Tuesday, 3rd March, at 8 o'clock P.M., when Mr. James Murrie will read the following papers:—(1.) "On the Processes employed in Italy for the extraction of Oils, etc., from bituminous rocks in that country." (2.) "Description of a series of New or Improved Thermometers for taking High Temperatures."

A meeting of this Section was held in the Rooms, 207, Bath Street, on Tuesday, 3rd February, 1885.

MR. E. C. C. STANFORD IN THE CHAIR.

ON BROMINE ABSORPTIONS.

BY EDMUND J. MILLS, D.SC., F.R.S.; AND JAMES MUTER.

In two previous communications to this Society (*Journal* 1883, 435; and 1884, 366), a series of constants of Bromine Absorption has been tabulated for a variety of oils and fats. In the present paper we give results for most of the important resins, for a few elements, and some interesting bodies of a different nature.

Throughout our work we have felt no personal ill effects arise from a few days' use of carbonic disulphide; accordingly we have employed it or carbon tetrachloride indifferently, as happened to be convenient; it being probable from certain experiments that, when small quantities of substance are taken, the absorption is almost always the same in either solvent. We have, however, indicated in all cases which solvent has been employed.

As regards resinous bodies, we found it best to proceed as follows:—The finely-powdered resin was placed overnight (together with the usual 50cc. of solvent) in the colorimetric bottles, and the next morning the bromine absorption was carried out. Sometimes β-naphthol was used for "titrating back;" more particularly—as in the case of pale resins—when the bromine derivatives had but little tint. Sometimes the operation was finished with hyposulphite (thiosulphate) and decinormal iodine, and sometimes the purely colorimetric comparison alone was employed. Except where otherwise stated, all the results are means of at least three determinations.

The letters S. and L. indicate that disulphide or tetrachloride was used respectively. The letters N., H. and C. indicate that the absorption was finally, measured by β-naphthol, hyposulphite or simple colorimetry. In nearly all cases the time of contact with bromine did not exceed an hour.

The names marked (*) represent commercial varieties of dragon's blood.

It will be observed that our experiments are divided into three groups, relating to (1 to 14) varnish resins, (15 to 34) tinctorial resins, (35 to 38) elements, (39, 40) oils.

The following substances gave no absorption in tetrachloride:—Benzoic, cinnamic, and salicylic acids; camphor, naphthalene and benzaldehyde.

The results with anthracene in tetrachloride were very peculiar. At 11° C., and with very cautious addition of standard bromine, the absorption was 88·67 per cent.; corresponding well with the ratio, $C_{14}H_{10} : Br_2$ (89·89 per cent.). At about 17°, the reaction was violent; much hydrobromic acid came off, and the absorption was 175·33 per cent., corresponding approximately with the ratio $C_{14}H_{10}Br_4$. (179·78 per cent.).

Some interesting features are noticeable in the tabulated results. Thus, the extraordinarily low absorption of shellac gives it a unique position among resinous bodies; and gum amber is distinctly below all other substances of its class. "Boiling" makes a measurable difference in copal; from which, again, kauri differs greatly. As a rule, but not invariably, the more soluble a gum resin, the greater is its bromine absorption.

For samples of all the tinctorial resins, excepting gamboge, we were indebted to Messrs. Dobbie and Henderson, who were at that time themselves investigating them from another point of view. Our bromine absorptions amply support their conclusion (*Pharm. Journ.*, Nov. 10, 1883), that the term "dragon's blood" represents several fundamentally distinct resins. The same may be certainly said of the xanthorrhœa resins.

As regards elementary bodies, it is remarkable that tin dust will not take up bromine in presence of carbon tetrachloride. The absorptions for commercial arsenic and aluminium are very peculiar, and would well repay further examination. Zinc dust takes up bromine in the proportion $Zn : Br_2$ (calculating 24·65 per cent. for pure zinc); and antimony in the proportion $Sb : Br_3$ (calculating 200·00 per cent. for pure antimony, our commercial sample apparently containing about six per cent. of impurities).

Aniline and Toluidine.—The great technical importance of these amines has induced us to devote special attention to them. It has already been shown (*loc. cit.*, 1883), that aniline, dissolved in carbon disulphide, absorbs bromine in the ratio $C_6H_7N : Br_2$. It is probable, in this case, as in that of the toluidines, that "additive" and not "substitution" compounds are formed. Our experiments with the toluidines relate to ortho- and paratoluidine only. Aniline oils contain very little meta-toluidine.

Para-toluidine.—This is the solid modification. The specimen had been prepared by one of us for a research on melting-point, and could be completely depended upon. Taking disulphide for the solvent, a standard solution of bromine, containing ·0115grm. in 1cc., and a weak standard solution of toluidine (in order to save repeated weighings), we found the results very irregular, and on the whole much too low, when quantities exceeding ·04grm. were employed. With that amount and under, the mean of three experiments gave an absorption of 74·47 per cent., with a probable error of ·18. This is in accordance with the ratio $2C_7H_9N : Br_2$, which requires 74·77 per cent. We also made a series of experiments with tetrachloride as the solvent, varying the strength of the standard bromine from ·0093grm. to ·0032grm. per cc., and the weight of toluidine from ·01grm. to ·03grm. The mean of five absorptions was 81·03, with a probable error of ·42. The chemical activity of para-toluidine in carbon disulphide is clearly less than in the tetrachloride; in the latter solvent, larger quantities than ·03grm. always seem to yield yellow by-products. It is evident that in this case the disulphide is a more advantageous solvent for analytical purposes.

Ortho-toluidine.—For this liquid modification we took ·025grm. toluidine, disulphide as the solvent, and standard bromine containing ·00483grm. in 1cc. The mean of six experiments gave an absorption of 151·34 per cent., with a probable error of ·53. The ratio, $C_7H_9N : Br_2$, requires 149·53 per cent. Our specimen, obtained from Kahlbaum, may possibly have contained a little aniline; but the difference from theory is only about 1·2 per cent. on the percentage. The chemical difference between ortho- and para-toluidine is very striking.

Mixtures of Aniline with Para-toluidine.—If the bromine absorption of a mixture of aniline with toluidine be known, the composition of the mixture admits of ready calculation. The quantities of mixture which we took were ·02 or ·025gm., the solvent being disulphide. Each result is a single

No.	Substance.	Absorption.	Remarks.
1	Shellac bleached	4·61	S. N. Chiefly insoluble.
2	Shellac	5·21	S. N. Chiefly insoluble.
3	Gum Benzoin	38·90	S. N. Partly soluble. Some hydric bromide given off.
4	Amber	53·53	S. C. Partly soluble. Some hydric bromide.
5	Animé	60·22	S. N. Partly soluble. Much hydric bromide.
6	Gamboge	71·56	S. N. Chiefly soluble. Much hydric bromide.
7	Copal, reduced to ¾ by boiling	84·52	S. N. Partly soluble. Much hydric bromide.
8	Copal	89·93	S. N. As above.
9	Sandarac	96·12	S. N. Partly soluble. Very much hydric bromide.
10	Kauri	108·22	S. N. Partly soluble. Some hydric bromide.
11	Thus	108·54	L. N. Chiefly soluble. Very little hydric bromide.
12	Dammar	117·91	S. N. Wholly soluble. Much hydric bromide.
13	Elemi	122·23	S. N. Wholly soluble. Very much hydric bromide.
14	Mastic	124·33	S. N. Partly soluble. Much hydric bromide.
15	Xantborrhœa, New Holland	7·11	L. H. Slightly soluble.
16	Xantborrhœa	8·33	L. H. Insoluble.
17	Calamus	8·37	L. H. Insoluble.
18	X. hastilis (grass tree), Queensland	9·11	L. H. Partially soluble.
19	Xanthorrhœa, Australia	10·35	L. H. Partly soluble. A little hydric bromide.
20	*C., Punjaub	10·45	L. H. Insoluble.
21	*C., Kew	11·97	L. H. Insoluble.
22	*Dracœna Cinnabari, Socotra	13.81	L. H. Insoluble.
23	X. hastilis, Australia	15·68	L. H. Insoluble.
24	*C. draco, Bombay	22·01	L. H. Insoluble.
25	X. hastilis, Tasmania	30·74	L. H. Insoluble.
26	X. hastilis, Sydney	33·25	L. N.
27	X. Preisii (Black Bay gum), W. Australia	36·93	L. H. Insoluble.
28	*C. draco, Kew	55·21	L. H. Insoluble. Partly bleached by bromine.
29	Sumatra	66·39	L. H. Partly soluble. Partly bleached.
30	C. draco, Singapore	73·81	L. H. Partly bleached.
31	Calamus, Menier & Co	74·58	L. H.
32	*Dutch E. Indies	81·59	L. H. Insoluble: bleached.
33	*Sumatra	81·87	L. H. Partly soluble. Partly bleached.
34	Tin	0·00	L. C. No absorption in twelve hours.
35	Arsenic	2·85	L. H. Twelve hours' absorption.
36	Aluminium	8·97	L. N. One hour's absorption.
37	Zinc	22·17	L. N. Twelve hours' absorption.
38	Antimony	187·73	S. C. Nineteen hours' absorption.
39	Sunflower oil	51·15	L. S. C. N. (1881). Sp gr. ·9245.
40	Haddock liver oil	109·81	S. C. (1881).

determination, carried out colorimetrically, except in the last case, where we give the mean of three experiments :—

Taken.		Found.		Bromine.
Aniline.	Toluidine.	Aniline.	Toluidine.	
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
25	75	24·66	75·34	98·90
40	60	45·98	54·02	119·60
50	50	48·37	51·63	121·90
60	40	61·14	38·86	131·32
75	25	72·06	27·94	141·90
90	10	88·95	11·05	161·32

The probable error per cent. of a single comparison of theory with experiment is, for either amine, 1·93 ; for a mean of three determinations (which we always recommend to be made), 1·11. There has apparently been some experimental slip in the work on 40 to 60 per cents., and we have excluded it from the calculation. With ten per cent. only of aniline, we have never been able to obtain satisfactory results. In such a case we should advise distilling off rather more than the aniline, and analysing the distillate and residue separately. As regards the analysis of mixtures of aniline and the two toluidines, all that is now required to complete the solution of the problem is a knowledge of the amount of some other element or compound with which these bodies combine. One of us is at present engaged with the investigation.

We wish to express our thanks to Messrs. Akitt and Ellis, who have given us very valuable assistance in the course of our work.

THE PROPOSED RIVERS POLLUTION BILL.

Mr. E. C. C. Stanford said : Before I call on Professor Mills to open this discussion, perhaps I ought to explain that the Council of the Society has communicated with us, and recommended that we should devote an evening to the consideration of this extremely important subject. There seems to be a pretty general consensus of opinion that the proposed Bill is so stringent that it is likely to defeat its own objects.

The London Section has already held a long meeting for the discussion of this question, and has passed a very important resolution condemning it out and out.

I shall say no more at this stage, because I know that the great standards of purity, referred to in this Bill, will be brought before you by one of the most able authorities on this subject—namely, Professor Mills.

Professor Mills, in opening the discussion, said : In the November number of the Society's Journal (1884), the attention of the Sections has been called to a "Rivers Pollution Bill," prepared and brought in in November last. The Council of our own Section arranged that the Bill should be considered to-day, and it has fallen to my lot to open the discussion.

In the first place, I think we must all have noticed from time to time the growing interest taken by the public generally in sanitary matters. Part of this is doubtless due to the now well-established connection between disease and certain insanitary conditions ; part to the ceaseless lawsuits between manufacturers and landed proprietors ; and part to the undoubted success of the Alkali Act. Anyone who watched the state of the popular mind during the recent outbreak of cholera. must have noticed how much more intelligent it has become of late years ; and we cannot be surprised that the framers of this Act should have supposed that the time was ripe for legislation.

The scope of the Act is very wide. It extends to all inland waters having a current, to canals, and even to estuaries : all these it forbids to be polluted by sewage or by effluents from manufactories of whatever kind, and the net of the penal clauses has been made capacious enough to enclose contributories to a pollution, even if their contributions have been in themselves perfectly harmless.

Up to the present time we have succeeded in devising processes for precipitating colouring and other matters, in removing chromates and arsenic, in preventing too great an acidity or alkalinity of an effluent, and so on. Tar is seldom or never at present a source of pollution, and a great deal of greasy matter and spent soap are now recovered. This shows us what may be done, and that in a large number of cases manufacturers have nothing to fear. On the other hand, they have much to hope ; because a really efficient Act, applied to all alike, would improve the water supply for every one of them.

Following the pattern of the Alkali Act, this Act purposes to set up standards representing limits of pollution. It is quite clear that the principle of standards must necessarily be applied in any Act really worth having. Every one in fact in his daily purchases, and other social transactions, sets up more or less consciously a large variety of standards of value. We do not eat butter perceptibly rancid, or drink milk that is obviously sour. It is the business of sanitary science to lay down the precise boundaries, which in no case we should be allowed to overstep.

The numerical standards of the Act are the standards of the late Rivers Pollution Commission. Taking them as a whole, my impression is that they are extremely liberal. There is little, if any, ground of complaint in restricting an effluent to (*c*) be colourless in a layer one inch thick ; (*d*) to contain less than two parts dissolved per 100,000 of any metal except calcium, magnesium, potassium, sodium ; (*e*) less than ·05 of *metallic* arsenic in combination or otherwise ; one part of (*g*) sulphur as sulphide ; or (*k*) less than ·05 part of hydrocarbon oil. Probably most of the differences of opinion would have reference to the remaining standards. These I will now consider.

(*a*) The *dry organic matter* is not to exceed one part in one hundred thousand. This standard is, in my opinion, insufficiently defined. It presumably means loss on ignition after drying at 100°. But that loss is certainly not all organic matter. It would be better to use the term "loss on ignition of the dry solid residue," and state exactly by what method the loss should be determined.

(*b*) *Organic carbon and nitrogen.* The former is defined by the Rivers Pollution Commissioners to be "carbon contained in the organic matter" of a water. The proposed Act limits its amount to two parts. It need hardly be said that no *potable* water ever contains this enormous amount. The limit, in fact, suggested for this by the Commissioners was only 0·2 part.

The method of determining organic carbon proposed by Frankland is, undoubtedly, not of the simplest character. It requires the evaporation of the water under specially maintained conditions, the combustion of the residue in a vacuum, and an analysis of the gases thereafter collected. A good deal of work is thus necessarily involved, and this of course entails expense. It is much to be wished that we had in our possession some less elaborate mode of carbon deter-

mination. But we must remember that the difficulties disappear when care and time are taken; those who have tried the process have soon got over them, and there is no lack of analysts who now practise the method. The analysts representing the London water companies determined in 1883 the organic carbon and nitrogen in daily samples of all the London waters, and they still continue to employ it. The independent monthly reports to the Registrar General also state organic carbon and nitrogen. This combustion method has also been employed with satisfactory results for the analysis of small quantities of organic substances obtained in original research. On the whole, then, we may take it for granted that a comparison of any given effluent with the proposed standards can always be had, if desired.

The standard suggested for organic nitrogen is ·3, exactly ten times the amount of the standard proposed for potable waters in 1874. Thus the Act can hardly be said to be of too severe a character as regards organic pollution. It might perhaps have been desired by some that "albuminoid ammonia" and "acid permanganate" standard should have been proposed. Both these processes undoubtedly detect very bad waters, and might conceivably serve the purpose of an Act. In my opinion, however, the proposers have done well to say nothing about them. These methods determine a fraction only of the carbon or nitrogen, as the case may be; it is certain that, in many cases, the value of this fraction can be increased by simply prolonging the action of the re-agents, and it appears to vary with the season of the year. Results of this nature are clearly less definite than those of combustion. The combustion process goes to the root of the matter at once; it gives us an entire and perfectly distinct result, with all desirable precision.

(*h*) *Acidity.*—The proposed standard is two parts per 1000 of real muriatic acid; it was originally laid down in the interests of fish life. As regards the susceptibility of fishes to chemical re-agents, the best work with which I am acquainted is the report (1868) of Penney and Adams, published in the Fourth Report of the Rivers Pollution Commission. These experimenters show that one part of muriatic acid in 10,000 is fatal to fish, while of sulphuric or nitric, as little as one part in 50,000 will suffice. The standard is therefore at least 100 times too great.

(*i*) *Alkalinity.*—The proposed standard is one per 1000 of caustic soda, but according to Penney and Adams, one of caustic potash in 35,000 is a fatal proportion. The limit for lime has not been determined, but is known to be very low. Again, alkalinity is one of the most effective conditions for the development of bacterial life, and could not fail to intensify the foul state of the foreshores in many places. In my opinion it is not necessary or expedient to permit any alkalinity, however slight.

(*f*) *Chlorine.*—The effluent, after acidification with sulphuric acid, is not to contain more than one part per 100,000 of free chlorine. By re-calculating the results of Penney and Adams, I find that ·5 per 100,000 is a fatal proportion. Here again the standard is not sufficiently restricted.

Viewing the Act generally, I cannot but think that a clause is required disclaiming all *permission* of pollution up to the limits of the standards. No one, for example, ought to be allowed by law to foul a stream, already pure, by converting it into a ·2 per cent. solution of hydrochloric acid. Riparian proprietors ought, in such cases, to have their existing rights reserved to them. Let us also trust that all manufacturers may be treated alike.

As regards the outlook for manufacturers, there can be little doubt that in many cases it will be necessary to erect subsidence and treatment tanks and filters, and in all cases to collect and store the rainfall. This will be required for dilution and flushing. Land, therefore, will be in demand in the neighbourhood of country and suburban chemical works. Urban factories unable to purchase ground will have to execute works to perform the purification vertically instead of horizontically, but in many cases this plan will necessarily fail, discharge into the sewers must still be had recourse to, and the question will become one of sewage purification. On the whole, I should strongly advise manufacturers to support the early passage of this or a similar Act. As the popular knowledge of this subject is constantly improving, we may depend upon it that postponement will not bring easier terms.

Summing up, then, these considerations, it appears to me (1) that an Act for the better prevention of the pollution of rivers is urgently required; (2) that the principle of standards is a good one, and ought to be maintained; (3) that the proposed standards are of a very liberal character, and perfectly accessible to analysis; but (4) that the chlorine, acid, and alkali standards are not sufficiently stringent to preserve the life of fish.

Dr. WALLACE: I have examined the new "Rivers Pollution Bill," with some care, and am glad to have this opportunity of expressing an opinion as to its merits and demerits. While, upon the whole, it is a distinct improvement on the Bill of 1876, it is imperfect, and I believe unworkable in many particulars. It appears to have been drawn up by men who, however eminent in scientific attainments, are only partially acquainted with the requirements and necessities of manufacturers. I have no doubt, however, that before the Bill is passed it will receive important modifications, such as would suggest themselves to any chemist who has had extensive experience in the difficulties of dealing with manufacturing pollutions.

At the outset I may refer to a very important part of the Bill of 1876—that is, section 7—which requires "sanitary authorities to afford facilities for factories draining into sewers," to quote from the rubric. It is proposed to repeal the Act of 1876. There is nothing in the new Act corresponding to the section to which I have referred, and I consider it a very important omission. I know of a case which dragged its weary course along for many months, the decision on which turned entirely upon this section 7 of the 1876 Act; and I have no doubt that there are many similar cases. It is necessary, therefore, that there should be some explanation regarding the omission of similar provisions in the Bill now under consideration.

The Act of 1876, except in so far as the section referred to is concerned, is about the most colourless and useless piece of legislation that can well be conceived; for all the prohibitory and preventive clauses are so explained away and hedged about with conditions that they are practically inoperative. We cannot say this of the proposed Bill of 1885, for the provisions are in some respects very stringent, and there is no escape from them. In one particular, however, the framers of the Bill are indulgent to a fault. They propose to admit into a river, stream or sewer any liquid possessing an acidity not exceeding two parts per thousand of real hydrochloric acid, or 140 grains per gallon. The admission into a river, still more into a sewer, of such a large quantity of acid is, in my opinion, most objectionable, and likely to lead to constant complaints. I would entirely prohibit the admission of acid of any kind to sewers or rivers; and I would have the less hesitation in doing so, because acid is easily neutralised by passing the refuse water over a bed of chalk or limestone, as is done in our own neighbourhood by Messrs. Stevenson & Carlile.

I propose now to refer to the standards of purity in the order in which they are printed in the Act. (*a.*) stipulates that no liquid containing in suspension more than one part of dry organic matter, or three parts of dry mineral matter per 100,000, shall be permitted to enter a stream. These quantities, being respectively ·7 and 2·1 grains per gallon, are, in my opinion, too small, and should be, at least, doubled. The river Clyde, above Glasgow, contains, during heavy floods, as much as 11 grains per gallon of suspended matter, mostly finely divided clay or mud; although in ordinary times the quantity is very small. Below Glasgow, ranging from Govan to Dumbarton, it contains, during ordinary weather, from 1 to 2½ grains per gallon of suspended matter, of which from ¼ to ⅓ is organic. No doubt the Clyde is a polluted river; but on many occasions the pollution in it and rivers generally, is caused, not by sewage or manufacturing refuse, but by the detritus of cultivated land; and is, therefore, entirely beyond the control alike of local authorities and manufacturers. On one occasion I had an opportunity of taking samples of the effluent from the sewage works at Birmingham, and of the river Tame into which the purified sewage flows. The effluent contained ·9 grain per gallon of suspended matter, while the river water had 14·2 grains, so that the sewage actually helped to purify the river. The same thing occurs at Bradford, when the sewage effluent, after filtration through breeze, is practically clear and colourless; while the water of the Beck is as black as ink, and very muddy besides. I admit that the rivers to which I have referred are more or less polluted, and would be vastly improved by the rigid enforcement of such an Act as that under discussion; but I fear that the high standard of purity aimed at is practically unattainable, or can only be attained by a pressure on our manufacturers, which will be very hard to bear, and which will inevitably lead to all sorts of evasions of a similar character to those practised under the Alkali Works Act. There is no one more anxious than I am to see our rivers restored to their pristine purity; but there is a possibility of pressing the manufacturers too hard, and driving the production into other countries, where such restrictions are unknown. If the proposed standards, as regards matter in suspension, were doubled, there would be no practical difficulty in complying with them. It is in this, as in many other things, the last straw which breaks the camel's back.

We now come to *(b.)*, relating to organic matter in solution. This it is proposed to limit to two parts per 100,000 of organic carbon, and ·3 of organic nitrogen. This I find, on calculation, to be sufficient for all properly purified sewage; but in regard to manufacturing refuse water it is a standard compliance with which would entail very great hardships upon proprietors of works of various kinds. Here, for instance, is an example of waste water from a paper mill draining into a beautiful river in the north-east of Scotland; the caustic liquor, of a dark brown colour, but not strong enough to pay the cost of evaporation, contains upwards of 2000 grains of organic matter per gallon, the spent bleach 55 grains, and the general drainage of the works, mostly washings, 50 grains. In the case of another paper mill in our own vicinity, the general discharge of the whole work contains 334 grains of organic matter per gallon. Now, the standard in this Bill, two of organic carbon per 100,000, is equal to only 3·5 grains of organic matter per gallon; and these works could not possibly comply with it. No amount of neutralising, settling, or filtration would reduce the organic matter so as even to approach the standard; and it seems to me that if the Bill were to pass into law in its present condition, it would simply put a complete stop to the operations of every paper mill in the country. There might, indeed, be a door of escape for those who were so situated that they could turn into their works an enormous volume of clean water, so that their discharge would be diluted ten or twenty fold; but this would be a mere evasion of the Act, and one which comparatively few manufacturers could take advantage of. Again, with regard to dyers, I had recently an opportunity of examining the final effluent of six dye-works, and in all cases the amount of organic matter in solution considerably, and in some cases greatly, exceeded the proposed standard. Distillers making raw grain whisky give a discharge which contains an enormous amount of dissolved organic matter: in one particular case, recently investigated, it contained 810 grains of dissolved organic matter per gallon, and in another no less than 2466 grains. I admit that a considerable proportion of this consisted of albuminous compounds, dissolved in lactic acid, which, if neutralised by lime, as is done to a partial extent in some distilleries, would have been precipitated; but even after this the discharge would have required an admixture of at least a hundred times its bulk of pure water to bring it down to the standard. I shall only refer to two or three instances recently brought under my observation: A tar distilling work gave a discharge containing fully 400 grains per gallon of dissolved organic matter, a tannery 72 grains, an oil-refining work 49 grains, a gut work fully 600 grains, a skin-dressing work 186 grains, a soap work upwards of 2000 grains, a slaughter house 26 grains. In fact, there is scarcely a manufacturing operation in which animal or vegetable substances are treated, in which the waste water does not contain an amount of dissolved organic matter largely in excess of the proposed standard; and I trust the manufacturing interests of the country will not be hampered by such conditions as would, in a great many cases, simply mean annihilation.

The next standard *(c.)* refers to colour, and it is a very absurd one. It condemns "any liquid which shall exhibit by daylight a distinct colour, when a stratum of it, one inch deep, is placed in a white porcelain or earthenware vessel." This is far too indefinite: what is a distinct colour to one person would not be held to be so to another.

(*d.*) "Any liquid which contains, in solution, in 100,000 parts by weight, more than two parts by weight of any metal except calcium, magnesium, potassium and sodium." This I think is sufficiently liberal for all ordinary manufacturing operations, but in regard to water pumped from mines containing shales highly impregnated with pyrites, and the drainage of blaes heaps of a similar character, there would be some difficulty. These waters frequently contain, besides much free sulphuric acid, 100gr. per gallon, or more, of oxide of iron and alumina in the form of sulphate, and the treatment of the water is both troublesome and expensive. At the same time it is most desirable that these refuse waters should be treated, and the oxide of iron and alumina separated, before they are permitted to enter a stream. I know one considerable river the water of which has been completely destroyed by mine and blaes-heap waters. On mixing with a large body of river water containing a certain quantity of lime and magnesia as carbonates, the acid is neutralised and a curdy precipitate of oxide of iron with a little alumina is formed. This gets into the gills of fishes and is very destructive of life. The river I refer to was formerly celebrated for its trout, but I understand that fish has now entirely disappeared.

(e.) Refers to arsenic and *(f.)* to chlorine (set free by the addition of acid), and I don't see any reasonable objection to them.

(g.) "Any liquid which contains in 100,000 parts

by weight, more than one part by weight of sulphur, in the condition either of sulphuretted hydrogen or of a soluble sulphuret." The difficulty I see in this provision is in regard to the drainage of heaps of alkali-waste, such as exist at St. Rollox and in the Newcastle district, Widnes, and several other towns in England. There are also in various places in the mining districts of England and Scotland enormous bings or heaps of blast-furnace slag, some of which, at least, contain enough sulphide of calcium to give a drainage water of a similar character to, although not so strong as, that from alkali-waste. The quantity it is proposed by the Bill to permit is ·7 of a gr. per gallon, but what do we find in practice? Why in the drainage of the Pinkstone Bog at St. Rollox there is over 900gr. per gallon of sulphur existing as sulphide and liberated as hydric sulphide in the addition of an acid, and in the general drainage of the heaps of alkali-waste there is more than 200gr. per gallon. Now, it is all very well for a scientific chemist to sit quietly in his laboratory and lay down the law to manufacturers—you shall not do this or that; but what are the manufacturers to do? Take the case of St. Rollox. I suppose it is no exaggeration to say that there are there something like 20 acres of ground covered by alkali-waste, and this will give an average daily drainage of, in round numbers, 50,000 gallons, a quantity the chemical treatment of which would be attended with considerable expense. More serious still is the question what to do with the drainage of the Pinkstone Bog, which derives its sulphur compounds from the same source which, although very strong in sulphur viewed as refuse water, is by far too weak to enable it to be treated chemically with any hope of recovering more than a mere fraction of the cost of working. These are an example of practical difficulties which should not be ignored in making out an Act of Parliament.

I have already spoken of the section relating to acidity, but *(i.)* relating to causticity demands a passing notice. It is proposed to allow in water flowing into a stream or river an alkalinity not greater "than that produced by adding one part by weight of dry caustic soda to 1000 parts by weight of distilled water." This is 70gr. per gallon, but whether it is intended by *dry caustic soda* to mean Na_2O or $NaHO$ I am not quite clear. In any case the allowance, as applied to the general drainage of a work, such as a paper mill, is sufficiently liberal, in fact rather too much so. Now the alkalinity may be caused by either potash, soda, or lime; and although I am not prepared to say that the effect of the two first mentioned alkalies would be very injurious to fish life, except perhaps in the immediate vicinity of the outfall, I am certain that lime in this proportion, which would be, in fact, lime water of nearly full strength, would be most destructive. The mere fact of the injurious action of lime is well known to the riparian proprietors on all rivers stocked with salmon and trout, but I am not sure that the cause of the destructiveness has been explained. My own explanation, which I offer with extreme diffidence, is that the lime, becoming carbonated, forms a precipitate which gets into the gills of the fish and impedes their natural action. A very moderate quantity of lime introduced into a small river has been known to kill thousands of fish. This clause, therefore, would require some amendation.

The last clause *(k.)* applies to petroleum or hydrocarbon oil, the quantity of which is limited to ·05 per 100,000 parts, or ·035 of a grain per gallon. This relates only to oil floating on the surface or in suspension, but a much greater evil in connection with discharges from paraffin oil works and tar and ammonia works is the tar-acids existing in solution. It is true that these would be restricted by the clause relating to organic carbon in solution, but the amount allowed under that section would be infinitely more objectionable than the ·035 per gallon in suspension. I know of cases where great difficulty has arisen from the presence of a small quantity of tar-acids in water.

I am of opinion that there should be a clause obliging manufacturers to mix all their drainage waters together and allow them time to react upon one another and settle thoroughly, for which purpose at least two tanks, each capable of containing a day's produce, would require to be provided. It is no uncommon thing to see two discharges from a factory, one acid and the other alkaline, and these passing into a stream at different places. A great amount of purification frequently results from the mixture of various effluent waters, and there is often a considerable precipitation. It is most important that the precipitation should take place in the works themselves and not in the bed of the river.

The greatest difficulty in carrying out the provisions of this or any other Act for the prevention of River Pollution will occur in the case of factories situated in large towns where ground required for the erection of tanks is very expensive, and in many cases unattainable at any cost. It may be said that those who have no such accommodation or cannot procure it should not be allowed to continue their business. It is also a truism that no man should have a family who cannot provide for its wants, but as a matter of fact such cases are only too numerous. The industries upon which the prosperity of the nation depends should, if possible, be led, not driven; and at all events not improved off the face of the earth by restrictions with which, in very many cases, it is impossible to comply.

In conclusion, I enter my protest against the principle of making a hard and fast rule applicable to all cases, no matter what the circumstances may be; and, especially demanding a higher degree of purity in an effluent or discharge than exists in the river into which it flows.

Mr. E. C. C. Stanford said: Our Society is not an exclusive one. We are always ready to accept light and intelligence, whether they come from the outside or inside. I am very glad to see present to-night several gentlemen who are eminently qualified to speak on this subject. Although they do not belong to us at present, perhaps they will soon. I have much pleasure in seeing Professor James Thomson, Mr. Deas, and Councillor Smith. All these gentlemen will no doubt give us something worth carrying away.

Mr. Deas (Engineer to the Clyde Trust) said: I am very glad to learn, for the first time, that there is a prospect of some legislation on the purification of rivers. I think there is no river suffers more, in the kingdom of Scotland at least, than the unfortunate Clyde. When I consider we have to dredge about 500,000 cubic yards of deposit every year, the bulk of which is from the detritus of the streets, manufacturing waste products, and from sewage deposit, I hail with pleasure any prospect of getting an alleviation of the heavy burden that the unfortunate Clyde has to bear. There can be no doubt that the River Clyde is a great deal more impure than it once was. You don't see any salmon further up the river now than Dumbarton Castle, and no fish will live from Bowling up to Glasgow. I should hail the day personally when an Act such as you have been discussing to-night would bring back the fish to our rivers and enable us to see the salmon sporting at the Broomielaw. I fear, however, this is a prospect that we have little chance of seeing.

Councillor Smith said: I came here to-night to

learn, not to speak. I expected to hear something concerning this Rivers Pollution Bill, for certainly we do need a Bill of some kind or another. There are, however, vast difficulties that present themselves to my mind, both from a chemical point of view, as has been described to you to-night, and from an executive point of view, in putting any Bill into operation. We have a vast number of people who maintain that rivers are the natural arteries, for the carrying away of the *débris* of pollution. We have the opinion of one of the most eminent agricultural chemists, given at the last River Thames Commission who in his report maintained that the whole of the London sewage went to feed the fish in the North Sea. I refer to Sir J. B. Lawes, who wrote a letter, which the *Times* published *in extenso*. I candidly confess that I felt puzzled in reading this letter, and could not see how any sewage could help the fish in the North Sea, about 40 or 50 miles away. This, however, is Sir J. B. Lawes' view, and it is hard to say anything in opposition to such a scientific agricultural chemist, and you will easily see that there is great difficulty in carrying any Bill that will not present to any man vast variety of action. It is all very well to say that so many parts of acid and so many parts of liquid can be allowed to go into a river, but you will easily see that if half a dozen works have some pollution issuing from them the river will get into a highly polluted condition, and yet they are all acting in accordance with the Bill. I have felt this a great difficulty, and if you permit pollution of this kind to flow into a river it ultimately becomes entirely polluted. I confess to you that the more I look at this question of pollution I feel the greater difficulty in knowing what to do with manufacturers, for as Dr. Wallace has shown you there are a great many who have no ground to operate on their water, and what are we to do with these men? Either the community must supply sewers to take this matter down to a purification place, or must permit them to use the public sewers, and we all know what a nuisance these are to the inhabitants of the cities. The difficulties of this question are certainly great indeed, and all that can be done is to grope steadily at it, and we will ultimately come to some clearer idea of it than we have at present.

Mr. Coleman said: I am scarcely prepared to offer any observations, but I have a little experience in works which help me to say a few words. It appears quite clear to me that the standards of purity, which are proposed to be universally applied, would be utterly impracticable to carry out. There is nothing in my opinion to prevent standards being established for different parts of the country, by grouping the local authorities, appointed under the Bill, into districts.* I think the Bill requires very considerable modification, and probably if it is so modified might become satisfactory. The scientific basis on which these standards are proposed is, I think, not perfectly clear. For instance Professor Mills' opinion is that alkaline water is to be avoided, because it encourages bacterial life, but we have the opinion of Dr. Angus Smith that putrefaction is the best possible thing to occur, because it gets rid of the organic matter. Moreover it may be a question whether the presence of organic matter may not be sometimes an actual benefit to fish as food; so that to lay down any general rule or establish any general principle by which standards can be framed for the United Kingdom is, I think, utterly futile.

Dr. Clark: It appears to me that the proposed Act is a considerable advance upon the Act of 1876. There can be little doubt that the present Act is a dead letter; and when we look to the cause we are led to the conclusion that this is due, in part, to the definitions. Thus, the Bill "prohibits solid matter from being discharged into streams," and when you come to the definitions you find that "solid matter" does not include matter in suspension, and that discolouration is not to be regarded as pollution. Again, we find also that, under the present Act, the sanitary authorities of the Local Government Board are the only parties who can institute proceedings against offenders; and they are expected to take into consideration whether there are good practical means of removing the pollution, and whether it would affect the trade or manufacture in question. Under these conditions, where there is so large a discretionary power, it is not surprising to find that the sanitary authorities are not inclined to take any proceedings against offenders, however great. In the present Bill, I observe that sanitary authorities will have less discretion allowed them, and that I consider a good feature. Another good feature is the introduction of standards. Without some standards of purity we are not able to grapple with pollution. We must, in my opinion, have standards laid down to enable us to decide what is pollution and what is not. The question, then, comes to be what particular standards are to be adopted? With most of the standards proposed I can find very little fault. I consider that rather too much acid and alkali is allowed; and I have no fault to find with the allowance of matter in suspension. The only two points to which I would take exception in the standards, are (1) "the limit of two parts by weight of organic carbon in solution." In some cases this is a considerable allowance; but in others, when the organic matter is of a harmless nature, it would press very hard upon manufacturers. Perhaps the particular standard of purity to which I take most exception is standard *(c)*, which follows: "Any liquid which shall exhibit by daylight a distinct colour when a stratum of it one inch deep is placed in a white porcelain or earthenware vessel," etc. Now if this was very strictly interpreted, there are very few liquids which would pass this standard; and we know that many of our waters, especially those of a mossy or peaty character, have a distinct colour when seen in a stratum of one inch deep. In order, therefore, to make this a practical standard, it is necessary to compare the colour of the discharge with the colour of the particular water as it reaches the manufacturer. It is only in that way that you can ascertain whether a water is polluted; and I think it only fair to allow the manufacturer some little increase upon the amount of colour—to what extent I am not able to say—otherwise it would be practically impossible for him,—especially if he is the owner of a dye works, or some work where coloured materials are used—to discharge his water into the stream again. In other respects I think the Act is, as I have already stated, a step in the right direction.

Mr. Tatlock said: I object to the Bill on two general grounds: first, because it treats all manufacturers alike. It is quite plain to every one who has a knowledge of a variety of manufactures, that while it would be quite easy, in some cases, to comply with the requirements of the Bill, it would be a matter of extreme difficulty, in fact it would be practically impossible, in many others to do so; and sufficient examples have been given. Second: I object to the Bill because it treats all rivers alike, no matter what their character or situation may be. It is evident that, while a commercial river like the Clyde, receiving so many discharges from chemical works, is not expected to attain to any great degree of purity, as the result of legislation, it is most desirable that rivers which are still unpolluted should remain so. I hold, therefore,

* Chemical referees being appointed for each district.

that much more stringent legislation is required for those streams which have not as yet been defiled, than for those which have been for many years in a polluted condition. I also am of opinion that some of the standards of purity are too loose, and others too stringent.

Professor MILLS said: As regards the hardship to individual manufacturers. No doubt there are many cases that would necessarily arise, especially in the case of manufacturers who have standard processes which have been going on for a great many years, and resulting in a great deal of pollution; they cannot be expected to reform these in a short time. I certainly think, in a vast majority of cases, that the pollution might be very fairly dealt with by an Act of this description; and in the majority of cases there would be no hardship. If I were about to set up a dye works, such as exist in the Vale of Leven, I should prefer to do so in the heart of Glasgow. I am quite certain that any pollution I should produce would be more leniently dealt with in any future bill, than it would be if I had gone to the outskirts of Glasgow. I think that we neglect sea water in a great many towns not far from the sea, that greatly pollute rivers, where it would be easy to pump up water to wash down the impurities. Then, again, after all that has been said and done, there will be cases of extreme hardship, and cases with which the scientific chemist cannot immediately deal. I think if there was a court of appeal to certify the cases that are exceptional, and a committee of experts appointed by the Home Secretary to see what could be done, that it would meet this difficulty fairly well. It has been thought desirable by the Council of the Society that we should come to some resolution on the matter; and as there is, I think, a general consensus of opinion that such an Act is necessary, although not perfect as regards detail, I therefore propose for your acceptance the following resolution: "That, although this meeting considers the subject proper for legislation, it does not approve of 'The Proposed Rivers Pollution Bill,' in many of its clauses, and instructs the committee of the Section to make such communications, as it may see fit, to the General Council of the Society."

Dr. WALLACE, in seconding the resolution, said: This resolution does not bind us in any way. It is simply an expression of what we have virtually decided upon—that the Bill, although good in the main, is imperfect in many of its details. It only commits us so far as that; and we, as a meeting, throw the matter upon the committee to report to the General Council in London upon the subject. The General Council have asked our opinion on this subject, and the least we can do is to give them the benefit of our counsel and advice.

Mr. STANFORD, in putting the resolution to the meeting, said: I would simply add that I am quite sure the committee will do their best to put the prominent points that we object to in this Bill before the General Council. I would mention one particular with regard to the standards, that although some of them have been proved by Dr. Wallace to be high (I allude to the carbon and nitrogen), those for the acids and alkalis are far too low. No one would dream of running a waste liquor into the river having anything like the acidity or alkalinity allowed by the Bill. It is remarkable that while so much is said about quality, nothing is said as to quantity, thus, as Dr. Wallace has already said, evasions can very easily be carried out. He fancied, probably, that they would not be, but my impression is that they would. There is no doubt that nothing can be easier than to pump a large amount of water from the river to dilute the effluent down to these standards and thoroughly come under the Act, and yet at the same time pass the same amount of pollution into the river. That appears to have been overlooked by the authorities. But why should we have any standards at all? It appears to me that a simpler way would be to require every one to put back into the river the water he drew from it in no worse state than he got it. With regard to the case of the Bradford Beck, to which allusion has already been made, it does seem absurd that the Corporation should have been interdicted for several years from passing their sewage into that river when it was thoroughly well proved that it would have made the river half as good again. My own opinion goes in favour of the suggestion made by one of the speakers in London, that we should go back to the Rivers Conservancy Boards. I think the rivers do want looking after, and would, in my opinion, be better looked after by a Board which does nothing else.

The motion on being put to the meeting was unanimously adopted.

Obituary.

SIDNEY GILCHRIST THOMAS.*

BORN APRIL 1850; DIED FEBRUARY 1, 1885.

WE regret to announce the death, at Paris, on Sunday morning, February 1, of Mr. Sidney Gilchrist Thomas, to whose genius and untiring labours the basic Bessemer process chiefly owes its existence. In him the metallurgical world has lost a bright and useful ornament.

Sidney G. Thomas was born in April, 1850, and was educated chiefly at Dulwich College, with a view of entering the medical profession. His father's death, however, rendered this impossible, and at the age of seventeen he entered the civil service. Though his position was connected with the administration of the law, a legal training was not a necessity; but it is an illustration of the thoroughness which characterised him that he devoted a considerable time to the regular study of law, in order, as he thought, to be better qualified for his daily work. His predilections, however, lay in a scientific direction, and to chemisty and metallurgy he was specially devoted. Engaged during the day, his only opportunites of study were in the evenings. A small laboratory at home was the scene of much of his study, in which he obtained further guidance by attendance at the laboratories of Mr. Arthur Vacher, of Great Marlborough Street, and of Mr. George Chaloner, of the Birkbeck Institution. However, Sidney Thomas was really an outcome of the admirable system of popular scientific instruction organised by the Science and Art Department.

It was in 1870, while attending a course of lectures on metallurgy at the Birkbeck Institution, that the idea of dephosphorisation first took strong hold upon his mind. To use an ex-

* For the matter of this obituary, the Editor is mainly indebted to the excellent article in *Iron*.

pression which at that time he was fond of quoting, "the man who eliminates phosphorus by means of the Bessemer converter will make his fortune"; and the commercial idea here expressed was quite as much in his thoughts as the scientific nature of the problem. In early conversation on the subject he frequently used to point out the product of a royalty of sixpence a ton on 3,000,000 tons annually of Cleveland pig. He proceeded in a strictly logical manner in the study of his chosen subject. Collecting all the data, both chemical and practical, he came to the conclusion, as Gruner had done, that the acid lining of the converter was the great enemy of dephosphorisation, and from this to the idea of a basic lining was a natural step. True, lime linings had been used in puddling furnaces before 1850. But the difficulty always had been to make them stand. Numerous experiments appeared to show that a small admixture of silicate of soda with lime, or magnesian lime, or Portland or Roman cement, would give good results, and about 1876 Thomas obtained the able assistance of his cousin, Percy C. Gilchrist, who was then chemist at the Cwm-Avon works, but soon after went to Blaenavon, where an immense number of experiments was tried. He systematically theorised and planned experiments, keeping up a continual correspondence with his cousin, who carried them out, besides working independently and conferring with him. His brief occasional holidays were spent in running down to South Wales and supervising the more important ones, and it was on one of these scientific journeys that the seeds were sown of the lung weakness which enfeebled his later years. In November, 1877, Thomas took out his first patent, the complete specification being filed on May 21 subsequently. Events, however, moved with him so quickly that in July 2, 1878, he says: "I regard it as somewhat out of date," and, as a matter of fact, patent succeeded patent up to the present year.

Matters up to this time had, of course, been kept very secret. He had but two or three confidants, but the need for experiments on a larger scale led him to seek the aid of Mr. Martin, the manager of Blaenavon, who enabled the experimenters to work with converters holding as much as half a ton, while at Dowlais, through the courtesy of Mr. Menelaus, a few blows were made with a 5-ton converter. On March 28, 1878, the first public announcement was made to the Iron and Steel Institute. Mr. I. Lowthian Bell had read a paper on the separation of phosphorus from pig-iron in a furnace lined with oxide of iron. Sidney Thomas was present as a visitor, and during the discussion made the following memorable remarks: "It may be of interest to members to know that I have been enabled, by the assistance of Mr. Martin, at Blaenavon, to remove phosphorus entirely by the Bessemer converter. Of course, this statement will be met with a smile of incredulity, and gentlemen will scarcely believe it, but I have the results in my pocket of some hundred and odd analyses by Mr. Gilchrist, who has had almost the entire conduct of the experiments, varying from the very small quantity of 6 lb. up to 10 cwt., and the results all carry out the theory with which I originally started, and show that in our worst cases 20 per cent. of phosphorus was removed, and in our best I must say that 99·9 was removed, and we hope we have overcome the practical difficulties that have hitherto stood in the way." It may be mentioned in this place that, although several persons worked at basic processes before Thomas, not a ton of metal was made by such processes before 1878. Then Thomas devoted his life to it, and, in 1884, 864,000 tons were made. His foreign patents proved a source of great profit, while in England but a small return has been made. The United Kingdom as a whole has contributed a mere trifle to the money rewards of the inventors of the basic process.

The exertion of constant travelling, combined with the anxiety of perpetual work, ultimately, however, ruined Thomas's health, which was never very robust. In 1882 he was ordered to pass the winter in Australia, whither he went viâ India, and returned through the United States. On this journey, however, he did much work, and came back in the early summer as full of ideas as ever. He only stayed in England a few months, and in September left again for Algeria, tended by an affectionate mother and sister, who had broken up their home to solace his exile. At Bir el Droodj he set up his habitation, including a laboratory, and worked away at the utilisation of phosphoretic slag and other problems. Last summer he moved north to Paris, where he submitted himself to a method of treatment which promised good results, but the improvement was only apparent, and the busy brain ceased its labours on the morning of Sunday, February 1.

Sidney Gilchrist Thomas was a man of high moral worth, and great amiability and kindness. Though never married, he was the central figure of a happy family, comprising a widowed mother, an only sister, and a younger brother. When success could no longer be denied him, he received the highest honours among metallurgists, but he received them with true modesty.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Filter-Presses. B. H. Remmers, Glasgow. Eng. Pat. 2978, February 8, 1884.

THE object of this invention is to facilitate the lixiviation of the solid matter collected in a filter-press before its removal from the apparatus. Instead of forming the channels which convey the washing water to the interior of the press in projecting portions or lugs outside the chambers, the patentee forms them in the corners of the chambers, such ducts being formed by the immediate contiguity of holes formed in the rims of the plates. The ordinal numbered chambers communicate with one passage so formed by means of small T-shaped cores, and the cardinal numbered plates communicate with the other passage by similarly shaped cores. Any liquid admitted into the chambers by one of these passages can only leave the apparatus, when the ordinary outlet cocks are shut, by the other channel, to arrive at which, the liquid must in its course pass through the chambers and their contents, and thus removes the soluble constituents in its passage. The patentee claims as novel the construction of the passages, as described, in the corners of a filter-press chambers for the purpose set forth.—C. C. H.

An Improved Compound for the Prevention of Incrustations, and of Galvanic Actions in Steam Boilers. M. A. F. Mennons, Paris. Communicated by R. de Martino, Meta Sorenta, Italy. Eng. Pat. 3644, February 20, 1884.

The improved compound consists of a mixture of chloride of lead, valonia, and chloride of ammonium, with the addition in some cases, when required, of carbonate of soda, or some compound capable of precipitating lime. The patentee divides waters into four classes, and in each case uses a mixture containing different proportions of the materials. The quantity added to the boiler varies, but generally in the proportion of about one quarter of an ounce per horse-power of boiler capacity per day. The claim is for a mixture for the purpose described, consisting of chloride of lead with organic products such as those specified, and alkaline salts.—C. C. H.

A Method of and Apparatus for Purifying Feed-Water in Steam Boilers. H. H. Lake, London. Communicated by G. Stollwerck, Cologne. Eng. Pat. 11,079, August 8, 1884.

The object of this patent is to provide means for freeing the water from impurities in the interior of the boiler itself, thus preventing incrustation. A diaphragm, slightly convex, running the greater part of the length, and nearly touching the sides of the boiler, is fixed in its upper part just below the water line. A series of perforated subsiding boxes are formed on the upper surface of the plate in a double row, communicating at one end only. On entering the first box, near the front of the boiler, the water is met by the steam and boiling water of the apparatus, and forced through the perforated boxes along the whole series. During its passage the mineral matters separate out and subside, the water falling into the boiler at the end of the series comparatively pure. The subsiding boxes are periodically cleansed. The patentee embraces under three claims the method, apparatus, and mode of using the combination as and for the purpose substantially described.—C. C. H.

Improvements in Filters. Geo. Cheavin, Boston. Eng. Pat. 11,390, August 18, 1881.

A cylindrical vessel, having a flat bottom and a movable cover, is provided at about one-fourth its distance from the bottom, with a perforated partition upon which rests a series of filtering beds of animal charcoal of different degrees of fineness—coarse at the top and bottom of the series, and finer in the centre. A perforated cup is placed in the upper portion of the filtering beds containing sponge, secured in position by a porcelain disc, which also covers the charcoal, and is cemented down so that no water can pass into the filter without going through the sponge. The part above forms a supply chamber. An air tube is formed reaching from that part of the apparatus under the perforated diaphragm in which the filtered water is received, to the upper part of the cylinder, and can be made available for cleansing the filter by forcing water through it so as to pass upwards through the filtering beds. The patentee claims—(1) the filter as described; (2) the combination of the permeable beds and the perforated cup; (3) filters with compacted filtering beds as described, provided with an air tube which can be used in the manner described for cleansing the filtering beds.—C. C. H.

A Combined Filter-Press and Montejus. George Fletcher, Poplar, Middlesex. Eng. Pat. 11,440, Aug. 19, 1884.

In order to economise space, and to use only one set of pipes and fittings, the patentee forms the montejus or forcing receiver as a tubular casting by prolonging the outside rim of the filter-press head, and providing the end with a flange and cover. The supply pipe to the filter-press, the charging and air inlets are employed in the usual manner. The claims are—

(1.) The combination of filter-press and montejus.

(2.) The method of working the filter-press by one set of fittings as described.—C. C. H.

Method and Apparatus for Purifying Water for Use in Steam Boilers. H. H. Lake, London. Communicated by G. H. Knott, Chicago, U.S.A. Eng. Pat. 11,661, August 26, 1884.

In order to remove lime salts held in solution in a water free from carbonic acid, the patentee proceeds as follows:—A vessel is provided having an inlet pipe near its lower part, provided with perforation on its under side. The interior of this vessel is filled with lime, freshly burned, and its upper portion communicates with a second vessel provided with diaphragms alternately open at the top and bottom, the cells so formed being filled with straw, hay, or some such material, forming a filter. The whole body of the water is passed through the lime in the first vessel, and from thence through the filtering apparatus, whereby the salts precipitated from the water are filtered out and retained. The patentee points out that this method of purification of water differs from Clark's method, because the whole body of the water comes in contact with the lime in bulk, and thereby renders the operation more effectual, and demands less skill in carrying it into effect. The claims are—

(1.) Treating water by passing it through lime in bulk succeeded by mechanical filtration.

(2.) A lime vessel in combination with a filtering vessel.

(3.) A lime vessel in combination with a perforated water supply pipe at its lower part.—C. C. H.

An Improvement in Filtering Apparatus. Johann Kroog, Halle-on-the-Saale. Eng. Pat. 12,520, September 17, 1884.

The object of this invention is so to construct and use a filter-press that homogeneous cakes are produced, and much of the difficulty of evenly and properly washing the cakes in the filter-press thereby removed. The corrugated surfaces of the plates do not terminate in deep cross drainage grooves as heretofore, which not only weaken the plates, but do not afford sufficient outlet for the filtered liquid; but are replaced by grooves formed in the joint surface of the lower part of the plate, which is made wider than usual. These communicate by several T shaped cores with the drainage face of the plates, and at their outer ends with the passage leading to the efflux cocks or the closed conduit often formed for carrying away the filtrate, without exposure to air. The distance frames are fitted at their upper part with air cocks, and the channel for supplying the material to be filtered is arranged at the lower part of the filtering chambers. The method of working the press so as to obtain the improved effect is also described: the efflux cocks on the plates are closed at the commencement of the operation, and all the air cocks opened, until the air is displaced and the chambers are completely filled; the air cocks are then closed, and the efflux cocks opened, filtration proceeding as in the usual way. The claims are:—1. The combination of the filtering plates and the outlet grooves as described. 2. The combination of the frames with an air cock. 3. The method and mode of working substantially as described.—C. C. H.

Improvements in Compression Pumps for Condensable Gases. S. Pulpett, Knowle. Communicated by S. Doran, Philadelphia, U.S.A. Eng. Pat. 13,917, October 21, 1884.

The object of this patent is to prevent the escape of such gases as ammonia vapour during compression, and to provide an efficient metallic packing for the piston rod, thus avoiding loss of gas during the time that the packing was renewed as heretofore. Another part of the invention has reference to constructing the inlet and outlet valves, so that they can be moved on their seats, on which they are apt to stick, without taking them out of their places. In the front cover of the cylinder a bush is provided, through which the piston rod passes, and capable of adjusting itself to the inequalities of the piston rod and cylinder; in front of this there is a suitable metallic packing and a spherical washer bearing against the wall of a sealing chamber, which is filled with water, or else some suitable lubricant. In front of this, again, there is

a leather collar to prevent the escape of the sealing liquid, and a second row of metallic packing. The cylinder is thus able to be made perfectly tight to the atmosphere, notwithstanding the irregularities of the cylinder and piston rod. The valves are made with a screw cap, which can be removed when necessary without letting any of the gas in the interior of the cylinder escape, and can be moved up and down on their seats, and thus sticking is prevented. The various details of the improvements are covered by seven different claims.
—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Recent Improvements in the Manufacture of Illuminating Gas and in Apparatus therefor. Dingl. Polyt. Journ. 253 (11), pp. 467 and 472.

H. Pollack, Hamburgh (Germ. Pat. 26,170, 1883), carburets air by allowing gasoline to flow from a vessel A (Fig. 1) into the carburetter B, where it comes in close contact with air entering through the pipes M. The gas, thus formed, can be used for many purposes, but it is

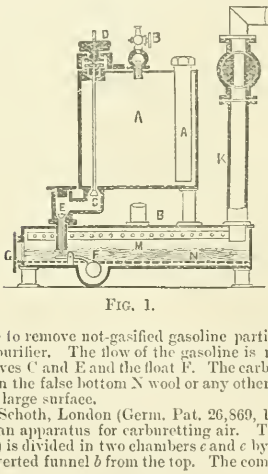
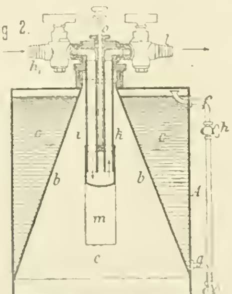


Fig. 1.

preferable to remove not-gasified gasoline particles in a separate purifier. The flow of the gasoline is regulated by the valves C and E and the float F. The carburetter B receives on the false bottom N wool or any other material offering a large surface.

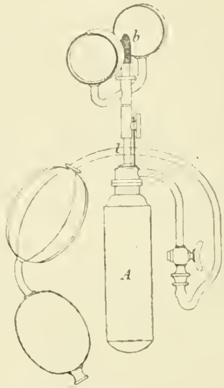
G. A. Schoth, London (Germ. Pat. 26,869, 1883), has patented an apparatus for carburetting air. The vessel A (Fig. 2) is divided in two chambers *c* and *c* by suspending an inverted funnel *b* from the top. The compartment

Fig 2.



c receives the carburetting agent, whence it flows through the pipe *g* into *c*, a branch *f* keeping it at a constant level. Air enters the chamber *c* through *i*, becomes carburetted, and escapes through *h*, a sliding cap *m* regulating the degree of carburetting at will. In Fig. 3 the

Fig 3.



lamp is provided with a pair of hand-bellows; the burner *b* sits immediately on the escape pipe *l*. Different shapes

Fig 4.

Fig. 5.

Fig 6.

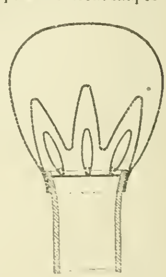
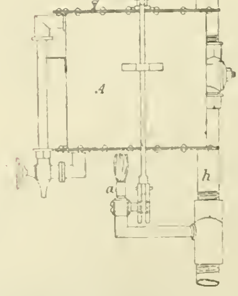


Fig. 7.



of burners are represented by Figs. 4, 5, and 6. They are made of wire gauze of platinum or any other metal, or

of a fire-resisting material. For smaller lamps a single cap is sufficient (Figs. 4 and 5); for large ones a combination of several caps is required (Fig. 6). On lighting the lamp, the tap is only turned on a little, but as soon as the gas-mixture is ignited, the tap is opened full-bore, whereby the gauze becomes incandescent without the formation of a flame.

F. A. Dicker, Hamburgh (Germ. Pat. 26,333, 1883), recommends for enriching poor illuminating gas to fix at a certain point of the gas pipes *h* (Fig. 7) a branch with tap *c*, through which vapours of hydrocarbons are directly passed into the gas. The vapours are generated in a small copper boiler A, heated by the flame *a*, and provided with a safety valve *d*.

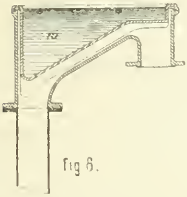


Fig 8.

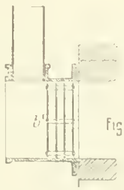
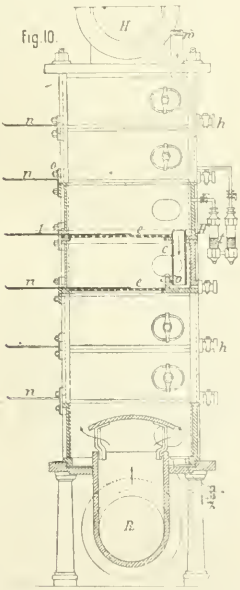


Fig 9

To keep clear the ascension-pipes of gas retorts, A. Klönne, Dortmund (Germ. Pat. 22,703, 1883), cools the gas in the ascension-pipe so far as to condense even easily volatile substances, which thus wash the sides of the pipe, carrying any sediment back into the retort. With this view a water-chamber *w* (Fig. 8) is arranged

Fig. 10.



in the bend of the pipe. In order to retain in the retort solid particles, and not allow of their being carried to the exit-pipe, a series of perforated metal plates *b* is placed within the head of the retort as shown in Fig. 9.

Kunath (*Journ. für Gasbeleuchtung*, 1884, p. 262) publishes his investigation on the causes which produce thin or thick gas tar. He comes to the conclusion that the nature of the tar depends upon the physical properties of the coal. If nut coals be gasified no thick is obtained, whatever the temperature may be at which the coal was distilled; the same coals, however, mixed with smalls and duff, will always produce a thick tar on distilling, even at a comparatively low temperature. The cause of a thick tar is principally the fine dust which is mechanically carried away to the exit-pipe and receiver. If a coal be used which is freed from all stuff passing through a 5mm. riddle, no thick tar can be produced, whatever the temperature may be. Smalls and dust must be worked up separately in a moist state or together with the double quantity of nut coals, with the precaution that the smalls are placed at the back end of the retort. Kohlstock and Jochmann, however, disagree with Kunath, and ascribe the formation of thick tar to a very high temperature of distillation.

The invention of L. A. Chevalet, Paris (Germ. Pat. 19,811, 1882), relates to an apparatus for purifying gas. Perforated shelves *c* (Figs. 10 and 11) divide the washing tower in several compartments, which are in connection with each other by the overflow pipes *e*. These dip in cups *e*, which on their part feed the partitions *c* with water. The gas enters the tower through R, and after

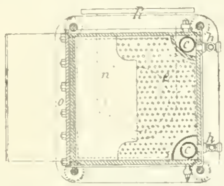


Fig. 11.

being thoroughly washed, it escapes at H. The washing liquor runs off at *z*. A manometer *t* shows the pressure in the different compartments, gas-tight dampers allowing of regulating the draught to a nicety.

The scrubber of A. Kühnell, Barmen (Germ. Pat. 45,356, 1883), consists of several compartments arranged

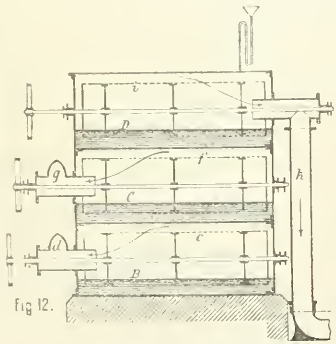


Fig 12.

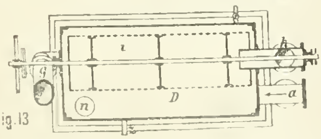


Fig 13

above or beside each other, and provided with perforated drums of sheet-metal. The crude gas enters the bottom chamber B (Figs. 12, 13, and 14) through the pipe *a*, passes through the holes of the slowly revolving drum *c*, proceeds through *d* to the chamber C, and so forth until

it escapes, deprived of its tar and ammonia, through the pipe *k*. Water trickles into the top chamber D, overflowing at *n* and *m*, and leaving the scrubber through the syphon *z*.

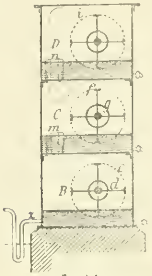


Fig 14.

Fig. 15

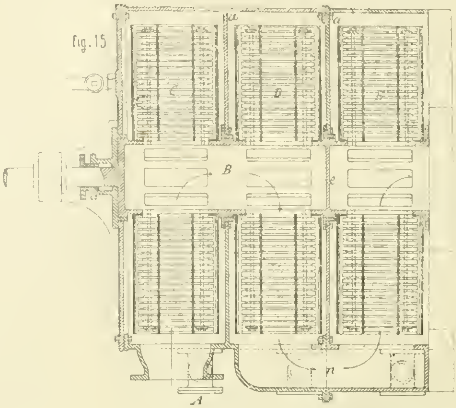
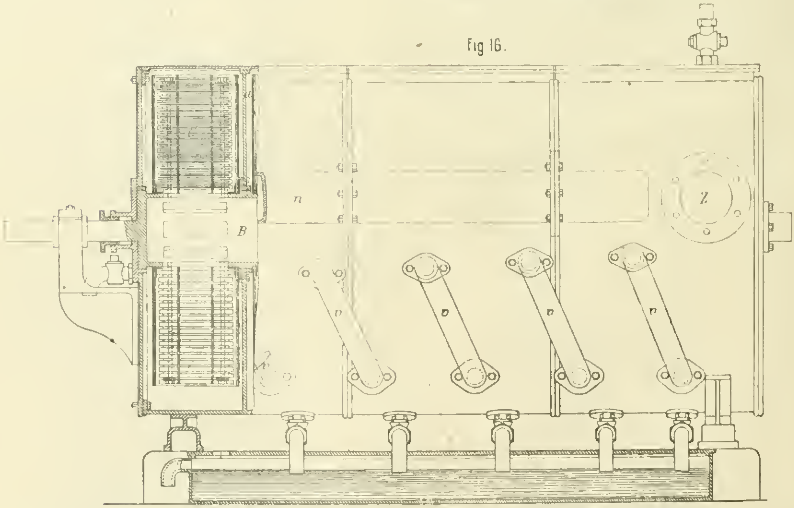


Fig 16.



The "Phœnix Washer Scrubber" of G. Waller & Co., London, depends on the same principle as Kühnell's. Partitions *a* (Figs. 15 and 16) divide it in several compartments in which cylinders, formed of wooden staves, revolve round a common hollow shaft. One half of the cylinders is always under water. The gas entering at A comes in close contact with the wet staves of the first drum, passes through the hollow shaft B into the second, and owing to the partition *e*, proceeds through the pipe *n* to the third, and at last escapes at *z*. The water travels through the apparatus in the opposite direction by means of pipes *v*.—S. H.

On the Origin and Distribution of Phosphorus in Coal and Cannel. Ad. Carnot (Compt. Rend. 99, 154).

THE author has experimented on a large number of different kinds of coal with respect to the proportion of phosphorus which they contain, and from the varying quantities of phosphorus in cannel, has arrived at the following conclusion: That the spores which chiefly occur in that particular coal, and which are easily visible with a microscope, contain the principal amount of phosphorus. The following percentages were found :—

Coal from Commentry	......	0·00163	per cent.
" " Ferriere	......	0·00385	"
Cannel from Commentry	......	0·01260	"
" " Lancashire	......	0·02852	"
" " Wigan	......	0·02216	"
" " Newcastle	......	traces	"
" " Glasgow	......	0·00572	"
" " Virginia	......	0·02771	"
Boghead coal from Autun	......	traces	"
" " " Frioul	......	0·06275	"

—J. C

Composition and Properties of Coal with relation to its Vegetable Origin. Ad. Carnot (Compt. Rend. 99, 253).

THE author has determined the composition and the action of heat with various samples taken from the coal-

beds of Commentry, the vegetable origin of which has been definitely ascertained. This has been carried out with a view of proving that not only the quality of the coal, but the nature of the original plant, exercises an influence. For in the same coal-bed the cause of all outward qualities, such as age, &c., must be identical. From the author's experiments it appears that the elementary constituents of the coal are closely allied; on the other hand, the amount of volatile products, the coke and its outward appearance on heating very dissimilar.—J. C.

On Lighting with Oil-Gas. By Shaar. Chem. Zeit. 60, viii. 1077.

THE author gives first an historical account of gas lighting, mentioning several investigators, such as Shirley, Lowther, Becher, Hales, and Claytons, and their works. Oil-gas was first introduced in Hull, Liverpool, and some other towns, but was soon given up, partly on commercial grounds and partly on account of the inefficiency of the apparatus. It is only within the last twenty years, and since the apparatus has been greatly improved by Hirzel, Riedinger, Drescher, Pintsch, Suchow, and others, that lighting with oil-gas has had a greater diffusion, and is still only to be recommended, in cases where the number of burners is limited. While formerly principally animal and vegetable fats were used, mineral oils or their waste products are now almost exclusively used. The oils which are best suited to gas manufacture are shown by actual experiment to be those having a specific gravity of 0·65 to 0·86. The amount of gas obtained is on an average of 45 to 60cb.m. of gas per 100kg. oil. The petroleum gas-oil of Artmann, of Brunschweig, yields 65 to 70cb.m.

Hirzel used his so-called ball retort, Hubner a standing slightly conical one, and Pintsch used two ⌒ shaped, which lay one above another, and which were connected. The temperature must be about 900° to 1000° C.; at a higher temperature a part of the gas is decomposed in the retort, by which a loss is sustained both of quality and quantity; if the temperature is too low, a part of the oil is carried away unconverted, which stops up both purifying apparatus and the pipes, besides making the gas give off soot. The oil is stored in receivers above the furnaces, from which it flows in a fine continuous stream into the retorts. The success of the manufacture depends upon the regulation of the proportion between the flow of the oil and the heat of the retorts. A great advantage of oil-gas over coal-gas is that it does not alter by being kept, whereas coal-gas suffers marked deterioration within 24 hours. The supply pipes can be much smaller than with coal-gas, because the same amount of light is produced with less gas. The burners must have very small openings, and the gas pressure must also be very small. To Pintsch is due its introduction for the lighting of railway carriages; it has also been used with success for the lighting of buoys. From the author's calculation of cost it appears that 1cb.m. costs 4·92 pence (41·24pf.). Supposing the consumption of one flame to be 30l. per hour, the cost will amount to 0·15 penny ($1\frac{1}{4}$pf.); as against 120 to 150l. the consumption in one coal-gas burner of equal illuminating power, which at a price of 20pf. per 1cb.m. gives 0·28 to 0·36 of a penny (2·4 to 3·0pf.).—F. T. S.

Improvements in Apparatus for the Purification of Gas. T. N. Kirkham, D. Hulett, S. Chandler, and J. Chandler, London. Amended Specification of Eng. Pat. 422, February 1, 1877.

A VESSEL of cylindrical or other suitable form is placed horizontally, and divided into a number of compartments by plates decreasing in height from the end where the gas makes its exit to the opposite end. Inside, and running the length of the main vessel, is a shaft working in stuffing boxes and fitted with sets of concentric or other tubes, or with a volute or louvres, each set working in one of the compartments above mentioned. Clean water is admitted as near the gas outlet as possible; gas is passed in at the other end and the shaft is made to revolve. This causes the tubes or their equivalents repeatedly to dip in the liquor, so that a wet surface is constantly being exposed to the passing gas. The arrangement of the division plates causes the water to flow in the opposite direction to the gas, which is also at its entrance brought into contact with the most concentrated portions of the liquor.—A. R. D.

Improvements in Purifying Gas. T. N. Kirkham, D. Hulett, S. Chandler, and J. Chandler, London. Amended Specification of Eng. Pat. 1814, May 10, 1877.

THIS is an improvement upon the invention mentioned in English Patent 422, February 1, 1877. The apparatus consists of the outer vessel therein referred to having, inside, a number of thin metal plates arranged to meet the gas edgeways and carried upon a shaft. This shaft being made to rotate, immerses the plates in the washing liquor contained in the vessel, and thus constantly exposes a wet surface to the gas. Drums of loose wire-work filled with light scrap iron may be substituted for the arrangement of plates. If more than one drum or set of plates is used, the outer vessel is divided into a corresponding number of compartments, the division plates being set at such different levels as to cause the liquor to flow in the opposite direction to the gas.—A. R. D.

Improvements in Apparatus for Condensing, Washing, and Purifying Gas. T. N. Kirkham, D. Hulett, S. Chandler, sen., and S. Chandler, jun., London. Amended Specification of Eng. Pat. 4928, December 29, 1877.

THIS specification refers to improvements upon the invention mentioned in English Patent 1814, May 10, 1877. Inside the outer casing is a central horizontal shaft, upon which are arranged clusters of annular plates kept a small distance apart from one another by washers to allow the passage of the gas between them. Each cluster of plates works in a separate chamber, and the arrangement is such that the gas traversing the apparatus enters each chamber from the preceding one at the central space round the shaft, and passes between the annular plates to their outer peripheries, whence it is again drawn to the centre to enter the next chamber. The lower portions of the chambers contain water, or other suitable liquid, in which the annular plates dip as they revolve, and which, by the disposition of the levels of the partition walls, is caused to flow through the apparatus in the oppositite direction to the gas. The original specification allowed the substitution of perforated discs for annular plates.—A. R. D.

Improvements in Apparatus for Coking and Distilling Coal. C. E. Bell, Durham. Eng. Pat. 443, January 2, 1884.

ACCORDING to this invention the walls of the coking oven, instead of being built solid, are provided with flues perforated for the admission to them of vapours from the body of the oven. The flues are preferably horizontal, and situated below the highest point to which the oven is charged. They are connected with a fan or exhauster, from the action of which they can be shut off at will by means of valves. When the oven is in operation the gaseous products are drawn off by the exhauster through these flues, and caused to pass through suitable scrubbers and condensers. The uncondensed portions are returned to the oven to be burned there. This arrangement of wall flues may be worked in connection with the plan of bottom apertures followed in the Jameson process. —A. R. D.

Improvements in Apparatus for Washing and Drying Coal and other Substances. C. E. Hall, Sheffield. Eng. Pat. 677, January 4, 1884.

THIS apparatus is for freeing small coal, or other substances, from dirt or other impurities of different specific gravity. The coal is fed through a hopper into a trough, a stream of water playing upon it as it falls. This trough

is provided with a series of settling pockets for the dirt, placed before division boards or weirs. At each settling pocket is a bye-pass trough, to divert the stream of water when the pocket is to be cleaned out. From the trough the clean, wet coal is delivered on to a perforated plate, covering a deep settling tank. The coal is worked over this plate by a creeper into trucks or other suitable receptacle. A pump draws the water out of the settling tank, and passes it once more to the hopper end of the apparatus, to be used over and over again. The suction of the pump is utilised to draw air through the perforated tank, and so partially dry the coal thereon. The finest particles of coal pass through the holes in the plate, and are deposited in the settling tank. The pipe conducting the water from the pump to the hopper is situated underneath the washing trough, and is connected with the dirt pockets by suitable valves, so that these can be flushed at will to stir up the contents and lift up to the surface any coal that may have settled therein.—A. R. D.

A New or Improved System of, and Apparatus for, Supplying Air for Combustion with Gas. Thomas Thorp, Whitefield. Eng. Pat. 962, January 8, 1884.

THIS invention consists in supplying air under a pressure greater than that of the atmosphere to the gas as it issues from the burners. In the case of ordinary downward burners, it is forced through a jacket surrounding the gas supply pipe, and so led to impinge upon the flame that it is possible by this means to burn gas under very low pressure in a downward flame. In the case of regenerative burners, the air is passed through the regenerator, and produces the same effect, also removing the necessity for using globes or chimneys. The air draught is obtained by any suitable apparatus. One method is to drive air or steam at high velocity through a nozzle, in a pipe provided with openings to admit air, thus inducing a current after the manner of an injector. —A. R. D.

A New or Improved Appliance to Gas Retorts for Preventing the Obstruction of the Ascension-Pipe. C. D. Abel, London. Communicated by A. C. Niemeyer, Deventer, Holland. Eng. Pat. 1195, Jan. 10, 1884.

To the underside of the bonnet or cover on the retort there is fastened by hinged joints a disc of such configuration as nearly to fit the sides of the retort, leaving between the two only a narrow interstice, through which the gas from the retort must pass on its way to the ascension-pipe. This disc being kept somewhat cool by its connection with the outer cover, a great deal of tar condenses, and small coal settles out thereon, which would otherwise have passed on to the ascension-pipe, and in time have blocked it up.—A. R. D.

Improvements in Apparatus for and Process of Purifying Gas. A. W. L. Reddie, London. A Communication from the Smith and Sayre Manufacturing Co., New York. Eng. Pat. 2341, January 29, 1884.

ORDINARY scrubbers, consisting of upright chambers filled with stationary scrubbing surfaces, are connected together in pairs, the connections being made in the lower portions so that the gas passes down the one scrubber and up the other. Of course any number of pairs may be worked in a series. The chambers are also connected at the bottom by overflow pipes, arranged at such levels that the washing liquor is continually making its way through the series of scrubbers in the opposite direction to the gas. A double-acting pump—one being required for each pair of scrubbers—pumps the liquor from the bottom to the top of the chambers, discharging it through a pipe perforated on the upper side, so that it strikes against the top of the scrubber, and, being beaten into spray, is more evenly distributed among the scrubbing surfaces. A new kind of scrubber, forming part of the invention, consists of an upright chamber filled with inclined rows or tiers of parallel tubes, through which a frigorific liquid is circulated. The exterior of these tubes form the condensing and scrubbing surfaces. The tube system is continued to the bottom of the chamber into the receptacle for the washing liquor, which is thus the more effectually cooled. Pipes are also arranged outside the scrubber for the cooling of the adjacent atmosphere by the circulation of the frigorific liquid. These scrubbers are to be arranged and worked as those described above.—A. R. D.

An Improved Arrangement of Air and Smoke Passages in the Setting of Retort and Muffle Furnaces. A. W. L. Reddie, London. Communicated by the Stettiner Chamotte Fabriks-Actien Gesellschaft vormals Didier, Stettin. Eng. Pat. 8144, May 23, 1884.

ACCORDING to this arrangement the products of combustion, after having passed uniformly through the furnace, are brought downwards and used for preheating the air necessary for combustion—the said air entering by passages contiguous to the smoke flue. These passages are so provided with outlets that only a portion of the total air admitted enters below the fire-grate. The rest enters the furnace at a point where it can be profitably employed to complete the combustion. The quantities of air admitted at each place are controlled partly by slides and partly also by the depth of fuel in the fire-grate. Below the grate is situated an iron water tank, under which the escaping hot gases pass on their way to the chimney. The steam thus generated, besides having a preserving effect upon the fire-bars, produces a further supply of fuel by its decomposition in the fire.—A. R. D.

Improvements in the Manufacture of Gas. S. C. Salisbury, New York. Eng. Pat. 9065, June 17, 1884.

THIS is an invention for the manufacture of illuminating gas from hydro-carbon oils and hydrogen, or from coal and hydrogen. The principle may be applied to ordinary gas retorts. During the first part of the distillation, when the richest portions of the gas are coming off, and (by the ordinary process) the bulk of the tar is condensed, hydrogen is supplied to the retorts. This reduces the gas to the desired quality, while the valuable hydrocarbons, which would otherwise be condensed as tar, go to form a fixed gas. At the end of the distillation, when the gas is of the poorest quality, it is enriched by the addition of hydro-carbon vapour. The hydrogen is generated by passing superheated steam over heated scrap iron, and is carried by a pipe to the rear of the retort. The same pipe may serve for the introduction of the hydro-carbon vapours later on. When the gas is to be made from hydogen and oil without coal, the pressure of the superheated steam behind the hydrogen is made to drive the hydro-carbon vapour through an injector into a chamber where the gases are thoroughly mixed and re-heated.—A. R. D.

Improvements in Furnaces for Use in the Manufacture of Gas. W. P. Thompson, Liverpool. Communicated by the Stettiner Chamotte Fabrik-Actien Gesellschaft vormals Didier, Stettin. Eng. Pat. 10,090, July 12, 1884.

THE channels of the regenerator, grouped on the right and left of the furnace, are so arranged as not to weaken the foundation of the centre of the setting. The air inlet passages between the regenerator channels are constructed to admit the air only at the upper part of the furnace, so that the heat is developed more gradually, and retained long enough to raise all the retorts to a uniform temperature. On each side of the furnace, closed wrought-iron steam-generating vessels are disposed above the flue conducting the waste gases to the chimney, and so arranged as to be easily replaceable. The generator has double walls, between which the air that it requires is heated before it reaches the grate. Here the air inlets are situated in a row, just above the steam jets, so that a perfect mixture of air and steam enters the grate. The steam generating vessel is provided inside with a box, closed at the top but open at the bottom, and communicating with an escape pipe outside. When the water level is too high, the excess flows away

by the escape pipe, while steam blowing out from the latter warns the fireman of a deficiency of water. An exhaust pipe conducts the steam to the grate. A special arrangement for the automatic regulation of the water supply consists of an iron vessel, communicating, by a pipe at the bottom, with the water inlet pipe of the steam generator. In this vessel is a hollow tinplate box, carrying a rod with a conical valve at the top, which closes the water supply. The tinplate box rising or falling, according to the water level in the steam generator, admits or cuts off the supply as required.—A. R. D.

Improvements in the Process of obtaining Ammonia from the Gases evolved from Blast Furnaces, or from the Gases produced from the Destructive Distillation of Coal, Shale, or other Carbonaceous Substances, and in the means employed therefor. R. Main and W. Galbraith, in the County of Ayr, Scotland. Eng. Pat. 10,448, July 22, 1884.

THE ammoniacal gases from the products of combustion evolved from smelting or blast furnaces, and retorts or other apparatus used in the distillation of coal, are directed into a large tank or tower made of a material impervious to the action of hydrochloric acid. The tank or tower contains an aqueous solution of hydrochloric acid, which may be injected into the same either in the form of spray or otherwise. The acid in falling to the bottom of the tower carries with it the ammonia present in the gases. The resulting solution is used over and over again, until it is sufficiently saturated with ammonia. In making ammonium sulphate from this solution of ammonium chloride, the latter is treated with lime, magnesia, or other alkali, and the ammonia which is driven off is saturated with sulphuric acid in the usual manner.—D. B.

Improvements in the Manufacture of Artificial Fuel. E. Johnson, West Cowes. Eng. Pat. 6556, August 29, 1884.

THREE measures of coal dust and half a measure of powdered chalk, moistened, intimately mixed, and pressed in moulds of size and shape as required, yield a fuel for which it is claimed that when used in combination with ordinary fuel it absorbs the smoke, engenders a greater heat, and prevents the formation of clinkers.—A. R. D.

Improved Apparatus for the Manufacture of Gas. A. M. Clark. A Communication from A. Henning and T. Henning, Sacramento, California. Eng. Pat. 12,481, September 16, 1884.

THIS apparatus consists mainly of a tank for holding gasoline, a distributing chamber into which the gasoline is fed by a bucket, and, below this, a generating chamber round the outside of which is arranged a set of burners. There is also a gasholder, which is so connected with the gasoline feed apparatus that the distributing chamber is supplied only when the volume of gas in the holder is small. The gasoline exudes from the distributing chamber by small openings therein into the generator below, and is there vaporised by the external heat of the burners. From here it passes through an injector (by means of which it draws atmospheric air along with it) into an intermediate chamber, and thence to the gasholder. The expansion and contraction of the generating chamber is made to effect the automatic regulation of the burners surrounding the said chamber.—A. R. D.

An Improvement in Furnaces for Burning Small or Moist Fuel. C. D. Abel, London. A Communication from G. Alexis Godillot, Paris. Eng. Pat. 3355, 1884.

THIS invention relates to modifications of the furnaces referred to in English Patents 1769 and 3839 of May 2, 1878, and September 3, 1881, respectively. The furnace chamber is fitted with a sloping or semi-pyramidal firegrate, upon which the fuel, delivered in at the top of the furnace, falls and burns, passing on meanwhile to a horizontal grate situated a little below the lower edge of the sloping grate. The space between the two grates allows for the insertion of a rake. The products of combustion pass away by a flue provided with a pocket for the settling out of dust, etc., and, to ensure a perfect combustion, receive on their way an additional supply of air heated by passing through suitable passages in the brickwork.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On the Manufacture of Lubricating Oils. J. Ljutyk. Dingl. Polyt. Journ. 253 (11), pp. 460-467.

IN one of the largest petroleum refineries at Baku the following process is employed for the manufacture of lubricating oils. The petroleum residues after driving

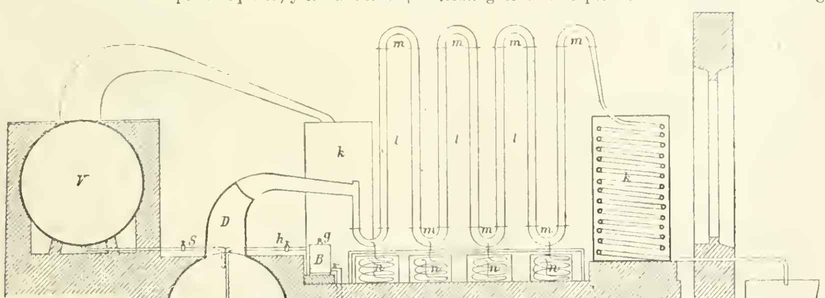


Fig 1

off all kerosene are run into large storage vessels, placed in the ground and large enough to hold at least 1640 tons of residues. They are then pumped into tanks high enough to allow of sufficient fall into the stills. In the tanks they are heated by a steam-coil to 70° C., whereby water and other impurities collect at the bottom, whence they are run off from time to time. After this preliminary preparation they pass through the heater V (Fig. 1) into the still A. This has the shape of a horizontal cylinder and holds 8000kg. residues, which are driven off in 24 hours.

By means of a furnace with waste oils as fuel, the contents of the still are heated to about 160° C., when the distillation is assisted by overheated steam. The vapours escape at D, and are condensed in the cooling worm K, made of iron or leaden tubes. Sometimes bent cast-iron pipes, *m*, *l*, allowing of the withdrawal of any condensed oils by a branch at the bottom, are interposed between still and cooling worm. The end of the latter is always carried through the wall to the receiver *p*, whence all uncondensed gases escape into the chimney. Where air and water cooling is combined, a partial separation of oil and water already takes place in the pipes *m*, *l*. The residues of the still sometimes serve as fuel. Besides horizontal, there are also vertical cylinders in use, provided with an arched top, and holding about 3200 kg., which are driven off in 12 hours. As regards the distillation itself, it is carried out differently in different works. Usually, when the distillate stands at 0·915-0·920, the outside heat is withdrawn and the operation finished by means of overheated steam until only little oil comes over. The still is then allowed to cool for two to three hours and the residue (goudron or deggut) is run off into tanks placed outside the building. If a larger yield of heavy oils be required, the distillation is interrupted as soon as the distillate stands at 0·912. After allowing the still to cool for some time, fresh oil is run into it without discharging the residues of a previous operation, and after heating the contents to 160-180° C. the distillation is carried on as described above. In this manner an oil is obtained which is rather viscid.

To refine the first distillate, any water is removed from it by means of hand-pumps, and the oil is then fractionated. The first fraction has a spec. grav. of 0·865, the second 0·875. Both are useless for lubricating purposes. The former is sold as gas oil, the latter to cloth mills for oiling wool. The fraction between 0·885 and 0·895 is separately collected and is an excellent lubricating oil, known by the name of spindle oil. The fraction having a spec. grav. of 0·895 to 0·910, is first-class machine oil; that higher than 0·910 is cylinder oil, which is sometimes mixed with the machine oil to raise the density of the latter. If a higher fraction begins to separate solid matter at common temperatures, it is separately collected and mixed with spindle oil, whereby second-class machine oil is obtained. In order to make isabonaptha or mineral machine fat, melting at 35° C., the residues of the still (deggut) are mixed with the fraction of 0·865 spec. grav. in the proportion of 3 to 1, and very slowly heated in a still to 180°-200° C., when the distillation is started by overheated steam. The fraction below 0·915 spec. grav. is of no use, but very soon a sample of the distillate separates on cooling, a solid matter which gradually increases until the whole mass solidifies at common temperatures. The distillation is continued until ⅔ of the charge has come over, when after cooling for 3 hours, the still is refilled without running off the residue. After heating up the contents, the distillation is carried on as far as possible. A second charge of deggut and light oil (0·865) is then run into the still, and the distillation repeated as mentioned above. The still must be cleaned at the end of every second operation. Original naphtha residues yield up to 12 per cent. of isabonaphtha. All fractions have at first a dark yellow colour and a characteristic disagreeable smell, but after purification with sulphuric acid and repeated distillation they become transparent and lose their smell. The treatment with acid takes place in lead-lined iron cylinders with conical bottom, the mixing being brought about by an air-blast. The end of the reaction is reached, when a glass-plate dipped in the oil shows many black flakes on its surface. The quantity of sulphuric acid varies from 5 to 10 per cent. of the weight of the crude oil, according to quality. The oil is clarified by settling in lead-lined wooden tanks. After one or two days the clear liquor is pumped into the mixing vessels and neutralised with slaked and sifted lime, of which so much is gradually added until the oil turns light-yellow and has a faint alkaline reaction. It is then run into the settlers and warmed to 70° C., whereby the gypsum quickly collects at the bottom. On account of the fineness of the precipitate, the oil must be, however, filter-pressed. It is then redistilled in vertical cylinder-retorts and collected in different fractions. The receivers have a contrivance to heat the oil up to 130° C., in order to evaporate traces of water which cannot be removed by settling. The residues of this second distillation, after cooling, are sold as waggon oil. The substance sold to cloth mills is refined in the same manner as the better class of oils, except that the neutralisation of the sulphuric acid is performed with dry potassium carbonate, of which so much is added as to give the oil a distinct alkaline reaction. For refining oils without a second distillation the crude oil is treated with sulphuric acid, neutralised with potassium carbonate, and after settling heated in iron pots to a boil, and lastly washed with hot water. The purification of mineral machine fat (isabonaphtha) is done in the same manner, but the oil is warmed to 80 C. before the addition of sulphuric acid. The settlers must be in a warm room or provided with a steam coil, since the mass solidifies at common temperatures. To raise its density, 0·5 to 1 per cent. of molten ceresine is added to the mass while still liquid.

—S. H.

Process for Working up Gas Liquor and Products from Gas Purification. Dingl. Polyt. Journ. 252, 476.

In order to convert the whole of the ammonia in gas liquor into ammonium carbonate, Seidler (Ger. Pat. 26,633, August 9, 1883) distils the liquor over limestone, dolomite and similar substances. Thus the non-volatile ammonium salts are decomposed, *e.g.*—

$$2NH_4CNS + CaCO_3 = (NH_4)_2CO_3 + Ca(CNS)_2.$$

The resulting ammonium carbonate contains some ammonium sulphide. It is therefore treated in concentrated aqueous solution with carbonic anhydride, and the precipitated ammonium carbonate is separated from the

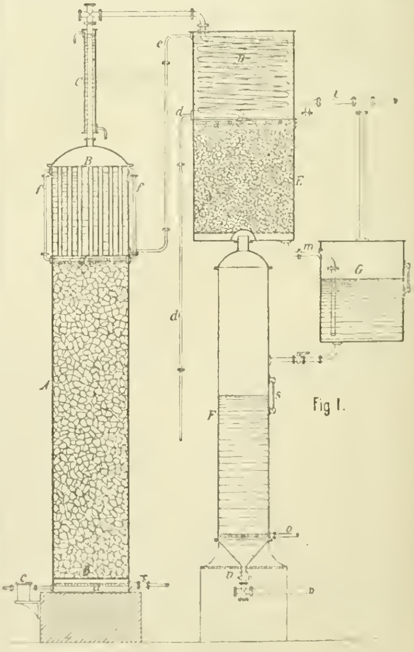
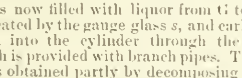


Fig 1.

mother liquor and converted into commercial ammonium carbonate by sublimation. The carbonic anhydride which escapes during this operation is passed into fresh portions

of ammonium carbonate solution, whilst the mother liquor is treated with sulphuric acid and worked up into ammonium sulphate. In working the process the gas liquor is pumped through the pipe *d* (Fig. 1) into the cooling vessel D in order to run through the pipe *e* into the heater B, thence through *f* into the spreading tube *g*, from which it descends through the charge of limestone contained in the cylinder A. Steam is introduced into A through the pipe *a* under the perforated bottom *b*. The non-volatile ammonium salts are split up into ammonium carbonate, which escapes with the steam and into the corresponding lime salts, so that the liquor on its arrival at the bottom of the cylinder is free from ammoniacal compounds. It is carried away by passing through an automatic steam trap *c*. The vapours of ammonium carbonate are partially freed from water in the heater B, and simultaneously heat the gas liquor which flows through B, after which they enter into the condenser C. The supply of water is regulated so that the vapours leave the condenser at a temperature of 65°, and are condensed into a concentrated solution of ammonium carbonate by passing through the coil in D. The solution, after filtering through the bed of coke in E, is collected in the tank G. The absorption cylinder F is now filled with liquor from G to a certain height, indicated by the gauge glass *s*, and carbonic anhydride forced into the cylinder through the perforated pipe *o*, which is provided with branch pipes. The carbonic anhydride is obtained partly by decomposing the mother liquors from the ammonium carbonate with sulphuric acid, but mainly from the gases given off in the manufacture of ammonium sulphate. A portion of the charge in the cylinder is now run off through *v* and the deposit of bicarbonate separated from the mother liquor, washed with water and dried at a gentle heat, or converted into ammonium carbonate by sublimation in apparatus of the ordinary construction. Every time a portion of the charge is let off from F, fresh ammonium carbonate liquor is allowed to enter the absorption cylinder from the tank G. The carbonic anhydride which escapes from the cylinder F passes through the charge of coke in the tank E, which is provided with a false bottom, and it is partially absorbed by the descending stream of ammonium carbonate That portion which escapes at *l* is conducted to a tower filled with coke and fed with sulphuric acid, where any traces of ammonium bicarbonate which may have been carried away mechanically are absorbed. The concentrated solution of ammonium carbonate is transferred to a horizontal cylinder provided with an agitator (Fig. 2)

Fig. 2.



and treated with carbonic anhydride, which is pumped in through the pipe *w*. The valve at *x* is left open until carbonic anhydride begins to pass through, when it is closed. The agitator is then set in motion, and carbonic anhydride forced into the cylinder until a pressure of five atmospheres has been reached. At first the carbonic anhydride is absorbed rapidly, afterwards the rate of absorption diminishes, the saturation being completed when the pressure, as indicated by the gauge *y*, remains constant after the working of the pump has been stopped. The liquor is then run off at *z*, and the ammonium bicarbonate separated from the mother liquor in the usual manner. For the recovery of ferrocyanides from products of gas purification Kunheim and Zimmermann (Ger. Pat. 26,884, July 6, 1883,) desulphurise the products in the usual manner and remove the soluble ammonium salts by lixiviation with water. The resulting mass is then dried in the air, mixed intimately with dry caustic lime in powder agitated in closed vessels and heated to from 40 to 100° to expel the insoluble ammonia. The product after extraction with water, yields calcium ferrocyanide liquors. The mixture after treatment with caustic lime may be first lixiviated with water, when an ammoniacal solution of calcium ferrocyanide is obtained. This is carefully neutralised and heated to boiling. An insoluble ferrocyanide compound is precipitated, which is mainly composed of the double ferrocyanide of calcium and ammonium, $Ca(NH_4)_2FeCN_6$. This on treatment with caustic lime in closed vessels is decomposed, the liberated ammonia being collected, whilst a solution of pure calcium ferrocyanide is obtained. This solution is worked up into Berlin blue by precipitation with protoxide salts of iron and subsequent oxidation. For the preparation of potassium ferrocyanide the liquors are converted into potassio calcium ferrocyanide CaK_2FeCN_6 by evaporating and treating them with the requisite quantity of potassium chloride. The deposited double cyanide is separated from the mother liquor, washed with water, and converted into potassium ferrocyanide by boiling it with a solution of potassium carbonate. For the formation of potassium ferrocyanide according to this method only half the usual quantity of potassium carbonate is required, the other half being supplied by potassium chloride, the cost of which is much less.—D. B.

Investigations on Thiophene Derivatives. R. Nahnsen. Berichte d. d. Chem Ges. 17, 2197.

SOME time ago the author obtained dithiënyl by passing thiophene through red-hot tubes. In the present paper, the analyses of the freshly-prepared substance have been repeated, and the results confirm the previous formula—

$$\begin{array}{c} C_4H_3S \\ | \\ C_4H_3S. \end{array}$$

Dithiënyl yields, on heating with concentrated sulphuric acid, a sulphonic acid; and by the action of bromine a perbromdithiënyl. Dithiënyl melts at 83° C., and boils constantly at 266°. It may be distinguished from thiophene by the action of concentrated sulphuric acid, which dissolves the former with a reddish brown colour in transmitted light, and with a deep green tint in reflected light. On pouring the solution into water the the unaltered substance separates out. Thiophene, on the other hand, forms, with sulphuric acid, a pasty mass.—J. C.

Action of Chlorine on Boiling Benzene. R. Schüpphaus. Berichte d. d. Chem. Ges. 17, 2256.

THE compound described by Meunier (*Compt. Rend.* 98, 436) had already been prepared by the author, and formed under the name of diphenyldodecachloride, the subject of a crystallographic investigation by Dr. Sölling. It is obtained in the preparation of hexachlorbenzene, and crystallises out with that substance in the form of octahedra. These octahedra can be readily separated with a pair of forceps from the large tabular crystals of hexachlorbenzene, or, better, by the method of Meunier, with alcoholic potassium cyanide. Pure recrystallised benzene gives the same body. From the analysis, the author considers the formula to be $C_{12}H_{10}Cl_2$, formed by the union of two molecules of hexachlorbenzene and the elimination of two atoms of hydrogen, an opinion which the high melting point (above 290° C.) seems to confirm.—J. C.

Comparison of the Methods of Fractional Distillation. Hans Kreis Ann. 224, 259.

THE author has fractionated mixtures of low boiling points (benzene and toluene), as well as those of high boiling point (benzoic acid and naphthalene), with the different forms of apparatus hitherto in use, and has published the following results:—For low boiling liquids the best fractionating apparatus is that of Hempel (Zeitschr. Anal. Chem. 20, [4]); next in order comes Linnemann's, with wire-gauze partitions. With the glass-bulb arrangement of Wurtz. six distillations are as efficient as twelve made without the bulbs, and two bulbs have the same effect as four. For substances of high boiling point fractionating with glass bulbs is decidedly preferable to employing a long necked vessel. —J. C.

Improvements in Apparatus for Carbonising Sawdust, Bagasse and Similar Substances, and for Condensing the Vapours of Distillation. Communicated by J. A. Mathieu, of Detroit, United States of America. W. P. Thompson, Liverpool and London. Eng. Pat. 9049, June 17, 1884.

This invention is not suitable for abstraction without the drawing accompanying the specification.—D. B.

Improvements in Apparatus for the Distillation of Solid Substances. B. P. Walker, Moseley; and J. A. Beresford, King's Heath. Eng. Pat. 2433, January 31, 1884.

This specification relates to improvements in a former patent. Retorts are arranged in pairs axially coincident, with a passage between the ends, two or more being placed in a row. The interiors of the retorts are fitted with a screw, the one of each pair being right-hand, the other left-hand, so that the thrust blocks before found necessary are not needed. The screws are driven by means of worms and worm-wheels, each worm being of an opposite hand to that immediately next to it on either side, so that all end thrust upon the driving-shaft, which would ensue if the worms were all of the same hand, is avoided. The retort screws may also be made in some cases of an increasing pitch; for instance, in the case of those materials which expand considerably during distillation, so as to avoid jamming or blocking; and in other cases the pitch may be made diminishing so that the material is compressed during distillation, which is found desirable with materials of a light nature. The patentees claim—(1) the arrangement of propelling screws in the retorts end to end, and of an opposite hand in the pitch; (2) the arrangement of the retorts in parallel rows, so that the thrust of the driving worms may be neutralised; (3) the construction of the main screws with an increasing or diminishing twist as described; (4) the arrangements of retorts as described.—C. C. H.

IV.—COLOURING MATTERS AND DYES.

Process for the Recovery of Aniline from Waste Liquors. Dingl. Polyt. Journ. 253 (11), p. 479.

F. Grässler, Cannstatt (Ger. Pat. 27,274, 1883), believes that aniline can only be partially recovered by the distillation of waste liquors. He therefore converts the aniline contained therein into valuable dye-stuffs. The neutral or alkaline liquors are treated with bleaching powder solution as long as a precipitate continues to form. The latter is filtered, separated from adhering lime particles by washing with dilute acid and dried. Digested with aniline and aniline chlorhydrate, a product is formed, which is soluble in alcohol with violet or bluish-black colour. For this purpose 2 parts of the precipitate, 1 part aniline oil and 1 part aniline chlorhydrate are heated in a vessel provided with a cohobator for $1\frac{1}{2}$ to 2 hours at 175° to 180° C. The product of the reaction is treated with hydrochloric acid to recover aniline, and employed either in alcoholic solution or sulphonised with 3 to 4 parts of strong sulphuric acid at 100 C. and converted into the sodium salt. In an acid dye-bath it produces nigrosine-like tints on the fibre, but with the advantage that it costs much less. The waste liquors may be also treated with chlorine, potassium permanganate, or potassium bichromate and hydrochloric acid as long as a precipitate is formed. This washed with hydrochloric acid to remove chromium compounds, etc., is either sulphonised or digested with aniline and aniline chlorhydrate, as mentioned above. The dye-stuff thus obtained is very much like the previous substance. In another process the author recommends to add to waste liquors containing aniline a dilute nitrite solution till it turns potassium iodide starch-paper blue. β-naphthol solution is then added, whereby β-naphtholazobenzene, $C_6H_5N_2\beta C_{10}H_6.OH$, is formed as an orange precipitate. If α-naphthol takes the place of β-naphthol, a dark brown precipitate is produced on adding an acid. In both cases the yield is theoretical. The naphthols may be also replaced by phenol and naphthol monosulpho acids. The β-naphthol-azo-benzene can be converted into the sulpho acid and its sodium salt, which can serve as a cheap substitute for orange II., whereas the α-compound prepared in the same manner cannot replace orange I. since it is chestnut-brown, assuming a violet tint with alkalis.
—S. H.

On the Preparation of the Sulphonic Acid of Methyl-violet. Dingl. Polyt. Journ. 254, 140.

In order to obtain the sulphonic acid of methyl-violet ("Paris violet"), an excess of sulphuric acid is added, the fluid is saturated with milk of lime, and the solution evaporated; the colouring matter, however, is partially destroyed thereby. According to a statement of the "Société Anonyme des Matières Colorantes de St. Denis," the excess of acid should be wholly or partially converted into a soluble sulphate, as of potassium, sodium, ammonium, magnesium, or zinc. Just enough water is then added to form with the dye a paste of moderate consistency. In this manner the colouring matter is obtained unaltered, and in a readily soluble form.—E. G. C.

Nitrotoluidine M. P. 91·5° from Liquid Dinitrotoluene. C. Ullman. Ber. 17, 1957.

Bernthsen has shown that liquid dinitrotoluene yields by reduction two nitrotoluidines, one melts at 77·5°, and has the constitution represented in the formula,

$$CH_3.NO_2.NH_2 = 1:2:4,$$

the other melts at 91·5°, and is probably that prepared in a less pure state by Cunerth. This last body is the subject of the present communication. By elimination of the amido group, orthonitrotoluene is obtained; and by converting the amido group into the hydroxyl group, and then eliminating the nitro group, salicylol is obtained, hence the constitution $CH_3:NO_2:NH_2 = 1:2:6$. The hydrochloride, sulphate and acetyl and benzoyl derivatives of this base are described. By complete reduction a diamidotoluene melting at 103·5° is obtained, and having the constitution $CH_3:NH_2:NH_2 = 1:2:6$; the other possible isomers have been already prepared. By the application of the diazo reaction to the nitrotoluidine, a nitro cresol $CH_3:OH:NH_2 = 1:2:6$ is obtained; it melts at 142°-143°. By reduction it yields an amido cresol ($CH_3:OH:NH_2 = 1:2:6$), melting about 124°-128°. By diazotising this a dioxytoluene is obtained, but the yield is very poor; it melts between 63° and 66°, and is probably identical with γ-isorcinol.—H. B.

A New General Method for the Synthesis of Aromatic Compounds. C. Friedel and J. M. Crafts. Ann. Chem. Phys. (6), 1, 449-532.

The paper is a monograph on the syntheses effected by the use of aluminium chloride. Most of the results obtained are already known, the following are new observations:— Amylbenzene, ethylbenzene, durene (tetramethylbenzene), pentamethylbenzene, and hexamethylbenzene, and some derivatives are described. Benzylchloride with benzene yields diphenylmethane, and with toluene, benzyltoluene, and apparently owing to admixture of the xylenes, also dimethylanthracene. Chloroform and benzene yield di- and triphenylmethane, and also anthracene and phenylanthracene. Carbon tetrachloride and benzene yield triphenylmethane, and some of its derivatives are easily obtained as secondary products. Acetylchloride or chloracetylchloride, and benzene yield acetophenone or chloracetophenone. Certain bromine derivatives of durylbenzoyl are described. Phthalylchloride and benzene yield a little anthracene and diphenylphthalide. Chlormethylacetate and benzene yield diphenylmethane. Ethylchloracetate and benzene yield ethylbenzene. Aniline or dimethylaniline hydrochloride and methyl chloride yield dimethyltoluidine. Chloride of sulphur and benzene yield thiophenol, phenylsulphide and diphenyl disulphide.—H. B.

The Colouring Matters of Bixa Orellana. Greshoff. N. Tijdschr. v. Pharm. Nederl., July, 1884.

THE air-dried fruit yields 2·046 per cent bixin. Heated, it is gradually decomposed; in contact with water and air, it is gradually decolourised. It does not reduce alkaline copper solutions, even after heating with dilute sulphuric acid.—H. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

New Forms of Singeing Machines for Fabrics. Dingl. Polyt. Journ. 254, 137.

IN a machine invented by M. Jahr, of Gera, a mixture of air and gas is conducted to the burners, a pipe either conveying gas and air simultaneously, or directing a stream of air into the gas before it enters the burners. The Tulpin machine has a contrivance for the rapid removal of the singeing rollers from the flames, so that the fabric can also be quickly removed.—E. G. C.

An Improved Method of Treating Vulcanised Fibre and like Material, to render the same Permanently Flexible. Franklin Taylor. Eng. Pat. 10,864, August 1, 1884.

THIS process consists in treating the vulcanised fibre, after it comes from the cleansing bath, and while yet soft, with a solution of a deliquescent salt, such as chloride of zinc, or a mixture of glycerine or sugar water with chloride of zinc. The strength of solutions employed is from 15° to 30° Baumé, according to the amount of softness required. Dry fibre may also be softened with the above solutions, but must be immersed in the bath for a longer time than the wet fibre, which requires from six to forty-eight hours, according to the thickness of the material and the flexibility required. The chlorides of tin, calcium and other deliquescent chlorides may be used instead of the chloride of zinc.—A. W.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

A New Process for Fixing Chromium. Dingl. Polyt. Journ. 254, 132.

HITHERTO there has been found no approved method of quickly and satisfactorily fixing chromium. It is not easy to fix chromium sesquioxide or its hydrate in an insoluble form upon fabrics, by its own mordant, as the processes followed for iron and alumina will not answer. Köchlin's method of printing the material with a mixture of potassium ammonium chromate ($K_2Cr_2O_7$ neutralised with NH_3), sodium hyposulphite (thiosulphate), and magnesium acetate requires powerful steaming, and the fibre is easily weakened: acetate of chrome only fixes slowly and unsatisfactorily by steaming. Köchlin has, however, recently suggested a better process, according to which a solution of a salt of chromic oxide, supersaturated with alkali by simple contact with the fibre, yields up its oxide to it, no drying being necessary. The material is put in a bath consisting of 2 parts by volume of chromic acetate (16°), 2 parts of caustic soda (36°), and 1 part of water, left in for 12 hours, and finally washed thoroughly, best in running water. Almost all the chromium oxide remains fixed in an insoluble form: the more alkaline the solution, the more durable and satisfactory is the result obtained. To 5 parts by volume of the above bath, a further part of caustic soda may with advantage be added, but in this case care must be taken that the alkali does not act upon the fabric. If only 1·5 part of soda were used, instead of the 2 parts recommended, the solution would soon become muddy, and after a time gelatinise. On the same principle, oxide of iron can be fixed upon vegetable fabrics, but as $Fe_2(OH)_6$ by itself is almost insoluble in alkalis, its precipitation must be prevented by the addition of some organic substance: the following mixture answers well:—2 parts ferric nitrate (40°), 2 parts caustic soda (36°), and 1 part glycerine (28°). Köchlin's method is very suitable for dyeing thread, etc.; it requires little manual labour, so that, where very dark tints are desired, there is nothing in the way of a repetition of the process. Cotton, prepared as described above, is rapidly dyed on immersion in a bath of gallocyanin, and if to the latter some quercitron extract be added, methylene blue, and a little tannin, a dark blue is obtained, which withstands well the influences of soap and light.—E. G. C.

On Alizarin Oil for Use in Print and Dye Works. Chem. Zeit. 53, viii. 946.

SINCE the introduction of the quick dyeing process, attention has been directed to the procuring of a Turkey-red oil, which will give a clear solution with an acid reaction, and at the same time be free from any foreign substance. The alizarin oil, which is at present in use, does not satisfy the requirements of consumers, nor is the quality always to be depended upon. "Oleocotonate" (*Ibid* viii. 65) is recommended as a substitute, as it has none of the drawbacks of the ordinary oils; can always be obtained pure, and of invariable quality; gives a clear solution with an acid reaction, and is quite as cheap. F. T. S.

To Test the Quality of Turkey-red Oil. By A. Müller-Jacobs. Dingl. Polyt. Journ. 253 (11), p. 473.

THE strongly diluted solution of Turkey-red oil (mordant liquor) treated with aqueous ammonia until it has an alkaline reaction should remain clear, and show no turbidity after the lapse of some hours. The turbidity would be caused by the presence of more or less considerable quantities of solid fats, or their glycerine ethers (palmitin and stearin), and proves that either very impure castor oil, or generally other crude oils, such as rape-seed oil, sesame oil, blubber oil, cotton-seed oil, olive oil, were employed for the preparations of the red oil in question. The precipitate only appears in strongly diluted solutions, and it can be observed more distinctly with common spring water, whereby insoluble lime salts of the fatty acids are produced. R. Bensemann (*Beitrag zur Untersuchung der Fette; Repertorium f. anal. Chemie*, 1884, vol. iv. p. 165) recommends as a test for the purity of oils, the determination of the melting point of the separated fatty acids. Those contained in cotton-seed oil melt at 42°-43° C., in olive oil at 26°-27° C., in rape-seed oil at 21°-22° C., whereas the mixture of fatty acids in castor oil remains liquid below the freezing point of water. The behaviour of the substance obtained by decomposing a Turkey-red oil with dilute acids at the boiling heat, also gives an indication of the nature of the raw material used in the manufacture; and whereas a good Turkey-red oil yields a substance readily soluble in dilute alcohol, the corresponding product of other crude oils is only little soluble in the same agent, gradually developing oily drops.—S. H.

Dyeing Vegetable and Animal Substances. Wm. Robert Lake, Southampton Buildings, London. A Communication to him from abroad by Edouard Crébassa, Chemist, and Baron Pierre Calnet Rogniat, both of Paris, France. Eng. Pat. 5670, December 7, 1883.

THIS Invention has for its primary object to dispense with the heat used preliminarily in the course of the dyeing operation, "this result being obtained by making use of a peculiar mordant to be described." Its composition is as follows:—

Water	100 parts.
Carbonate of soda	5 parts.
Hypochlorite of lime	1·5 part.
After preliminary solution, dioxide of barium	0·1 part.

This mixture is diluted according to requirements. The bath is boiled and allowed to settle for a quarter of an hour, the clear liquid decanted into another vessel and mixed with ten centilitres of glycerine in order to precipitate the acid matters left in the decanted liquid. After cooling, the mordant may be immediately employed for dyeing purposes. "The advantages of this process are the following:—The suppression of the use of heat

applied by steam or otherwise; a saving of time in dyeing, the series of operations not lasting more than one hour, the better fixing of the colour, hot or cold washing having no effect upon articles dyed by this process. The said articles also resist the action of light, and are unaffected by the temperature of the atmosphere."
—H. A. R.

Manufacture of Lactic Acid and the Lactates, etc. A. G. Brookes, London. Communicated by T. S. Nowell, Boston, U.S.A. Eng. Pat. 5780, December 18, 1883.

THE object of this invention is twofold: (1) the production of lactic acid; (2) the production of a mordant, the essential feature of which is the presence of lactic acid. The process for the production of the lactates is as follows:—Any starch producing vegetable substance—*e.g.*, maize, rice or grain—in the form of meal, is mixed with warm water, at 40 to 45° C. To this a liquid, containing a lactic ferment, is added; and in order to neutralise the acid as fast as it is formed, carbonate of lime is added. The proportions may be 100lb. of maize meal, 300lb. of water, 40lb. of the liquid ferment, and 50lb. of carbonate of lime. The resulting product, after fermentation, is neutral calcium lactate. The lactate crystals are digested with hot water, filtered, and sulphuric acid is added, sulphate of lime being formed, and acid calcium lactate liberated. After filtration the solution is concentrated and set in a cold chamber, never above 7·5° C.; the solid crystals are pressed to remove the mother liquor, and are then ready for use. A variety of other substances, such as dextrin, inulin, gum arabic, may be fermented by the aid of soluble nitrogenous matter, and a like result secured. It is necessary, during fermentation, to avoid agitation, otherwise the lactate will be decomposed with the production of butyric acid. The second part of the invention is carried into effect by mixing four parts of the lactic acid with one part of oxalic acid. This mordant is chiefly useful in dyeing animal fibres, etc., the violent action of the oxalic acid being checked by the lactate, at the same time securing the rapid opening of the pores, and an increased bloom and softness of the dyed material, together with a superior fastness to soap, and at a lower cost than the tartaric acid mordant commonly in use. The patentee claims (1) the method of forming the lactic acid by fermentation of amylaceous vegetable substances, with water charged with a neutralising agent; (2) the treatment of the neutral crystals thus obtained as described, and the production of the acid crystals; (3) a mordant composed of four parts of lactic and one part of oxalic acid.—C. C. H.

VII.—ACIDS, ALKALIS, AND SALTS.

Production of Sulphuric Anhydride from Nitrosulphonic Acid. Dingl. Polyt. Journ. 254, 139.

O. V. GRUBER prepares sulphuric anhydride, not from sulphuric acid, but from the so-called chamber-crystals. To obtain these, he introduces a series of small chambers between the chamber-system and the Glover's tower. These contain, after a while, the gases in the requisite proportions for the formation of the compound

$$2SO_3.N_2O_3.H_2O.$$

The crystals are freed from nitric acid, and nitrogen compounds generally, by heating in acid-proof retorts, through which dry air, or a mixture of oxygen and sulphurous acid, is passed.—E. G. C.

Tungstic Acid and its Compounds. A. K. Huntington. Eng. Pat. 222, January 1, 1884.

AN alkaline tungstate is formed by fusing the naturally occurring tungstates (*e.g.*, wolfram and scheelite) with carbonated or caustic alkalis, with or without the addition of a siliceous or other flux. The alkaline tungstate being of great specific gravity, sinks to the bottom, and may be tapped off; or, after partial cooling, the slag may be removed, leaving the tungstate. Should the tungstate contain impurities, it may be refined by fusing it again, with addition of some substance such as silicate of soda or glass, that will take up the impurities and form a slag that can be separated, as above described, from the tungstate. The tungstate thus obtained is available for use, or it may be dissolved in water and crystallised, or treated for the production of oxide of tungsten and metallic tungsten.—F. L. T.

Improved Baking Powder. Andrew M'Donald, Langside, Renfrewshire. Eng. Pat. 306, January 2, 1884.

BISULPHATE of potash or bisulphate of soda is substituted for the tartaric acid or cream of tartar generally used in the composition of baking powders. As an example the inventor gives the following mixture:—Rice flour, farina, or other flour, 1 to 2oz.; bicarbonate of potash or soda, 1oz.; bisulphate of potash or soda, 1 to 1½oz.—J. M. H. M.

Improved Furnace for Recovering Soda-Ash. G. Hitchen. Eng. Pat. 1308, January 12, 1884.

THIS process is to recover soda-ash from esparto or other liquor. Fig. 1 is a sectional elevation, Fig. 2 a sectional plan, and Fig. 3 a cross section on the line A B of Fig. 1. A is the fire-place situated at or near the middle of the furnace; on each side of the fire-place are one or more

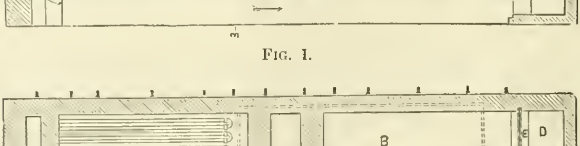


FIG. 1.

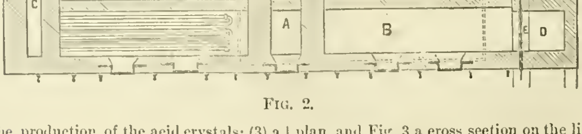


FIG. 2.

calcining or burning-off chambers BB. C is the flue from the left-hand chambers, D the flue from the right-hand. The gases from the flue C may pass under the furnace so as to enter the flue D, as indicated by the arrows; or the gases from the two flues may be carried away separately. E is the door between the chamber or chambers at the right-hand side of the furnace and the flue D; the cor-

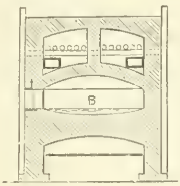


Fig. 3.

responding door on the left is not shown. The liquor, evaporated to the consistency of a syrup, is run to the two sides of the furnace alternately, the doors communicating between the chambers at the two sides, and the flues being alternately opened and closed, so that the process of calcination takes place in the chambers at each side alternately, and is therefore practically continuous. —F. L. T.

Decarbonating Carbonate of Strontia. J. Imray, Middlesex. Communicated by Hippolyte Leplay, Paris. Eng. Pat. 1998, January 23, 1884.

An improvement on a previous process. Moist carbonate of strontia or baryta, moulded preferably into the form of tubes, is charged into retorts, and heated in an atmosphere of steam. Anhydrous strontia is thus produced in a condition to be removed from the retorts by raking out.—G. H. Bkt.

Manufacture of Hydrochloric Acid and Sodium Carbonate. E. Carey, H. Gaskell, and F. Hurter, Widnes. Eng. Pat. 2117, January 25, 1884.

Sodium chloride and hydrogen sodium sulphate are heated together to redness, hydrochloric acid being evolved, and neutral sodium sulphate produced. This neutral sodium sulphate is dissolved in water, and certain impurities are removed from the solution, into which ammonia and carbonic acid gases are then passed, sodium bicarbonate becoming precipitated, and the solution then contains ammonium sulphate, sodium sulphate, and ammonium bicarbonate. Or instead of the gases, ammonium bicarbonate may be prepared separately, and then added to the sodium sulphate solution. The sodium bicarbonate is separated by filtration, and calcined. The solution is heated in stills to drive off the volatile ammonia compounds, and evaporated further to dryness, leaving a mixture of sodium and ammonium sulphates, which, on being heated in an atmosphere of steam, becomes converted into free ammonia and hydrogen sodium sulphate, ready for use over again.—G. H. Bkt.

Ammonium Chloride. T. Heskin. Eng. Pat. 2491, January 31, 1884.

To obtain ammonium chloride: Sodium borate is decomposed by sulphuretted hydrogen under pressure, the precipitated boric acid is dissolved in strong ammonium hydrate, forming ammonium borate, which then appears to undergo double decomposition with common salt, producing ammonium chloride and sodium borate. —F. L. T.

Improvements in the Treatment of Certain Residual Salts formed in the Manufacture of Caustic Alkalis. Jno. Healey, Liverpool, Geo. Pryde, Liverpool, and W. H. Swim, Runcorn. Eng. Pat. 2796, February 6, 1884.

The crude salts eliminated from caustic alkali solution by fishing during concentration are, preferably when in solution, oxidised by the addition of nitre or the blowing in of air, etc., and then dried and fused. The iron, as also a large proportion of the silica and alumina, sinks to the bottom of the fusing vessel, and the clear, hot liquid above is drawn off, allowed to cool and broken into pieces for use as required.—A. R. D.

Manufacture of Bichromate of Soda. By Thomas Carlile and James Park, Millburn Chemical Works, Glasgow. Eng. Pat. 3392, February 16, 1884.

The object is to obtain non-deliquescent anhydrous crystals. A solution, obtained in any way, is concentrated until the hydrated salt melts in its water of crystallisation, and is then introduced into a steam-jacketed vessel, provided with a mechanical stirrer. The vessel is heated by steam to a temperature not exceeding 200° C., and the solution is agitated by means of the stirrer until all the water has been expelled, and the salt has separated in a mass of anhydrous granular crystals.—J. M. H. M.

An Improved Process for Extracting Sulphur from Sulphide of Hydrogen. G. F. Redfern, London. Communicated by Dr. H. von Miller and Carl Ope, of Hruschau, Austrian-Silesia. Eng. Pat. 10,743, July 29, 1884.

Sulphuretted hydrogen is passed through a retort or series of tubes filled with fragments of gypsum and kept at a red heat. The outlet communicates with a suitable condenser for the liquid sulphur, which separates according to the following equation:

$$CaSO_4 + 4H_2S = CaS + 4H_2O + 4S.$$

The residual calcium sulphide may be reconverted into sulphate by blowing air through the retorts. The caloric generated by this operation is utilised to heat another retort in which the decomposition of sulphuretted hydrogen is going on.—A. R. D.

Improvements in the Manufacture of Potassium Carbonate and Bicarbonate. Fannie Brown, London, relict of W. Cowell Brown, deceased. Eng. Pat. 11,007, August 6, 1884.

Potassium nitrate is mixed with carbonaceous material such as coal-dust, and subjected to pressure to diminish the bulk and lessen the rapidity of combustion. This mass is burned in suitable vessels, and the ash washed, clarified, and crystallised, or treated in solution with carbonic acid for the production of bicarbonate. The carbonic acid is derived from the combustion of the nitre and coal-dust.—A. R. D.

Improvements in the Manufacture of Carbonate of Soda. Fannie Brown, London. Eng. Pat. 11,008, August 6, 1884.

Nitrate of soda and coal dust are burnt as in the preceding patent (11,007), and the ash washed. The solution is concentrated for crystallising, or evaporated to dryness by the combustion of the carbon monoxide generated in the first operation.—A. R. D.

Improvements in the Manufacture of Bicarbonate of Soda. Fannie Brown, London. Eng. Pat. 11,009, August 6, 1884.

The carbon monoxide produced in the manufacture of carbonate of soda by the combustion of nitrate of soda and coal-dust is used as fuel to evaporate the soda solution to proper strength, and the carbon dioxide resulting from its combustion is utilised for the conversion of the carbonate of soda into bicarbonate.—A. R. D.

A New and Improved Process of Dissolving the Lime out of Phosphates or other Calcareous Minerals to form a Caustic Solution capable of replacing Soda in certain operations, with consequent Enrichment of the Residual Substance. Michael Cahen, Brussels. Eng. Pat. 11,336, August 16, 1884.

Phosphatic limestone is calcined to drive off the carbonic acid, and then moistened to slake the lime

D

contained. The mass is then boiled with calcium chloride solution which dissolves out the lime, leaving a residue of almost pure calcium phosphate. The solution of lime thus obtained is, on account of its valuable detergent properties, capable of replacing soda in many industries. At least two parts of calcium chloride and six parts of water are required to dissolve three parts of lime.—A. R. D.

Improved Apparatus for Making Salts of Ammonia. W. Arrol and J. Meikle, jun. Eng. Pat. 12,174, September 9, 1884.

THIS apparatus is for the production of ammonium salts from the ammonia distilled from gas liquor, etc., by combining it with acid. Fig. 1 is a plan, Figs. 2 and 3 vertical sections as at right angles to each other. The ammonia combines with the acid in a copper vessel (4), rectangular in plan, one half being permanently covered by a curved dome (5), which, in transverse section as seen in Fig. 3, is a continuation of one outer side of the vessel, whilst it is at its inner part continued downwards in a partition or curtain (6) dipping down a little below the surface of the acid, the dome and curtain thus enclosing a space above one part of the acid. The bottom (7) of the vessel is made with a deeper part or recess (8), which latter is at the part not covered by the dome (5); and in this recess (8) there is placed a copper dish or tray (9) to receive the crystallised salt of ammonia. The acid is supplied by a pipe (10) as required, and the gaseous ammonia is conveyed from the still by a pipe (11) connected to a horizontal pipe (12) placed on the higher part of the bottom (7) and close to the vessel's side furthest from the recess. The horizontal pipe (12) has perforations made in it on the side facing towards the middle of the vessel, and the jets of vapour issuing from them produce currents in the liquid which carry the crystals as they are formed into the tray (9). When a quantity of crystals has accumulated in the tray, it is lifted out of the vessel (4) and the crystals are emptied from it into a receiver (13), a framing (14) being constructed over the vessel and having fixed on it a pair of rails (15) on which runs a small wheeled truck (16) fitted with a pulley (17). A movable cover (24) is provided for covering the open part of the vessel, excepting when the tray is being moved in or out. A pipe (25) is connected to the dome to carry away sulphuretted hydrogen, etc.—F. L. T.

FIG. 1

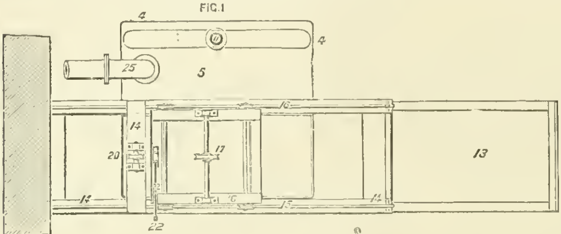


FIG. 2

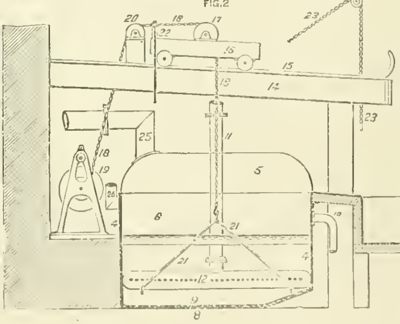
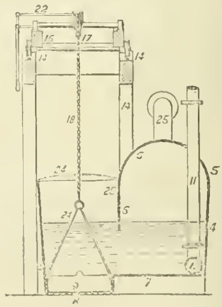


FIG. 3



Production of Carbonate of Ammonia. William Edward Gedge. A Communication from Frederick Carl Glaser. Eng. Pat. 5761, December 17, 1884.

THE process consists in heating salts of ammonia with equivalent quantities of alkaline carbonates, to which a small quantity of bicarbonate has been added. The reaction takes place in a very perfect manner, and the product is exceedingly pure.—E. J. B.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Manufacture of Improved Plastic Compounds. M. Mackay, Camberwell. Eng. Pat. 5467, November 20, 1883.

THIS invention relates to the manufacture of compositions suitable for moulding into such articles as screw stoppers for bottles, jars, casks, and similar vessels; for brushes, the bristles of which are secured in plastic materials; for buttons, and for various other articles required to stand a high degree of heat, whether dry, moist, or liquid. For screw stoppers and other articles requiring to be free from taste and smell the following ingredients are employed in about the proportions given:

75 pounds of lac (preferably shellac).
38 ,, ,, gum sandrac.
38 ,, ,, rosin.
38 ,, ,, ivory black, or other fine carbon.
168 ,, ,, asbestos, or silicates.

The resins being melted in a suitable vessel, the carbon is added and thoroughly incorporated with the liquid mass, after which the "asbestos or other fibrous matters or silicates" are put in the vessel. The whole is well stirred until it forms a stiff paste, which can be moulded in dies or rolled into sheets. Other ingredients, when

heated, can be mixed and worked into a paste by being passed through hot rollers. This composition is not affected by either dry or moist heat at 200° F., nor by hot water at 210° F. When it is immaterial that the composition should be free from taste and smell, gum kauri can be substituted for the gum sandrac, and asphaltum for the carbon.—E. G. C.

Improvements in Continuous and Semi-continuous Kilns for Burning Bricks, Pottery, etc. H. Knowles, Woodville, Leicester. Eng. Pat. 351, January 2, 1884.

THE object of this invention is to secure increased facility of control in the working of the kiln and in the transmission of heat from one chamber to another, and also the economy of the heat produced. A series of kilns is constructed in a line separated from each other by partition walls. The kilns are of the down-draught type, and are provided with fireholes and shield walls; the outlet flue from each chamber is in communication with a connecting flue having branches to the main channel leading to the chimney, and also in communication with the adjoining chamber by a flue in the interior of the partition wall, emerging into the chamber by perforations; both of these flues are controlled by dampers. Each chamber communicates with the adjoining one directly by an opening at its upper part closed by a damper. The first chamber of the series is lighted after being filled with the green goods, and put in communication with the chimney, until all the steam has passed away, when it is put into connection with the next of the series through the flue formed in the partition, and so on until the whole series is in operation and utilizing the heat given off by the first chamber. When the goods in the first chamber are finished, the flue through the partition is closed, and the chamber short-circuited into the next one, in which the fire has been lighted in the meantime, so as to equalise the excess of heat in the first chamber between the two; as soon as this has happened the top flue is closed, the air-holes opened, and the interior allowed to cool. The same operation is carried out with the whole of the chambers in succession, more even results being given, and that with considerable economy of fuel. The claims are—(1) the construction of kilns as described, with partition walls having flues, passages, and dampers; (2) the construction of kilns having, as described, a communication and damper at the top; (3) forming a fireplace in the opening, between the chambers claimed in (2); (4) the combination of the various flues, passages, etc., as described; (5) the general arrangement and combination of parts constituting the kiln as described.—C. C. H.

Improvements in Ovens or Detached Kilns for Burning Bricks, Pottery, etc. H. Knowles, Woodville, Leicester. Eng. Pat. 352, January 2, 1884.

THIS patent deals with improvements in down-draught detached ovens or kilns, and its object is the utilisation of the waste heat of any furnace of a series of such furnaces, when used for burning bricks, pottery, etc. A series of furnaces is built preferably in a line; it has one common connecting flue, which between each furnace is in connection with a common main flue leading to the chimney. Dampers are to be placed between each furnace so that they may be thrown into circuit through the common connecting flue, or put into direct communication with the chimney. Distributing flues communicate between the connecting flues and the space formed between the walls and the interior central downward flue which passes out of the body of the furnace through the perforated bottom. The *modus operandi* is as follows:—The fire in the first furnace of the series is lighted and the damper in the connecting flue closed, that in the main flue to the chimney opened; when the steam from the green goods has quite ceased the heated products of combustion are sent through the next of the series until the goods in that likewise are dried, and so on until the whole series is working on the products of combustion from the furnace first lighted. The whole of the heat is thus utilised before entering the chimney. As soon as the goods in the first furnace of the series are completed, its fire is cut off from the rest of the series, and the fire is lighted in the second of the series, and so on until the complete operation is ended in the whole of the furnaces or kilns. The patentee claims (1) providing circular ovens or kilns with the connecting and branch flues as described; (2) providing rectangular kilns with a similar arrangement of flues for the purpose described; (3) the combination of parts forming the whole series of kilns as described.—C. C. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Chemical Changes which Accompany the Hardening of Hydraulic Cements. H. le Chatelier. Bull. Soc. Chem. 42, 82-89.

THE setting of hydraulic cements is the effect of the crystallisation of dissolved substances; in ordinary mortars the act of drying in addition plays a part. The most important body concerned in the hardening of hydraulic cements is the compound $CaO.SiO_2 + 2{\cdot}5H_2O$ — this formula has not been obtained by analysis, but by analogy with the crystallised compound $BaO.SiO_2 + 3H_2O$—which is decomposed by water into free lime and a salt of silicic acid ($2SiO_2.CaO + Aq.?$); by carbonic acid and water into silica and carbonate of lime. The first decomposition is arrested when the water contains 0·052 per mil. of lime. The formation of this silicate by hardening is produced either by combination of the two constituents or by decomposition of silicates richer in lime, or perhaps by simple hydration of the anhydrous compound. The compounds of lime with oxide of iron or alumina which can exist in water in presence of excess of lime have the formula $R_2O_3.4CaO.12H_2O$ (R = Al or Fe), and are split up with water alone, but decomposition stops in presence of water containing, at 15, ·225 and ·6 per mil. of lime respectively. Iron and alumina are important as fluxes in preparing the mortar by bringing the silica into combination with the lime. The absorption of carbonic acid is of no moment in the hardening of cement, calcium carbonate always forming a superficial layer. This layer is, however, important, for, as the carbonate gives up a minimum quantity of lime to water, the durability of the cement is thereby increased. —J. C.

Improvements in the Manufacture of Cement and Apparatus therefor. R. Stone, London. Eng. Pat. 153, January 1, 1884.

THE improvement in the process of manufacture consists essentially in grinding the materials in a red-hot state, giving a better prepared material with less consumption of power. The burnt clinkers pass red-hot through steel crushing rolls of special construction, and thence to the grinding rollers, the bed plate of which is made concave and adapted to the lower roll, so that the crushed material after passing between the rollers is further ground between the lower roll and the bed plate. A moulding machine is described, also a machine for grinding the slurry, constructed on the principle of a pestle and mortar.—H. J.

Improvements in the Manufacture of Cements. F. W. Gerhard, Wolverhampton. Eng. Pat. 1504, January 16, 1884.

TO certain impure silicates of alumina and iron the patentee adds lime, and claims "to make cement from the rotch bat or bovin, and what is known as black lime in this district, in the way above described."—H. J.

Improvements in the Manufacture of Portland Cement. E. W. Harding, Bishopwearmouth. Eng. Pat. 1707, January 18, 1884.

THE patentee claims the application of gaseous fuel, in kilns of special construction, to the burning of Portland cement, together with the utilisation of the waste heat,

for the carbonisation of coal and the heating of the drying floors. Also the mixing of a certain proportion of resin with the cement mixtures to assist the calcination.—H. J.

Improvements in the Manufacture of Portland Cement. R. W. Lesley and J. M. Willcox, of Philadelphia, Pa. Eng. Pat. 1884, January 22, 1884.

THIS invention has for its object to enable cement powder to be moulded into forms or shapes suitable for the kilns, as respects size, adaptability to free draught, and the like, while dispensing nearly, if not altogether, with the water ordinarily required to bring it to the pasty condition for this purpose. The object in view is attained by compressing the powdered materials, merely damped with water, but not in a pasty condition, by heavy pressure between rollers having cells or cavities wherein the powder is moulded into blocks of the requisite size. Several modifications of the process are described, in one of which about four per cent. of any liquid combustible are added to the damped materials.—H. J.

Improvements in the Manufacture of Artificial Stone, Paving Slabs and Blocks. J. Elliott and F. J. Parsons, Hastings. Eng. Pat. 3363, February 15, 1884.

THE object in this invention is to provide artificial stone blocks with hard adamantine wearing surfaces. The body of the stone is composed of a mixture of sea-shore boulders, Bath, Portland and York stone well crushed and mixed and saturated with water; with three parts of this mixture one part of Portland cement is mixed. The blocks are cast in suitable moulds, in which space is left for the addition of the hard facing surface, which is made by mixing finely crushed and sifted Kentish rag and Bath stones with an equal part of cement. The face of this coating is again made harder by the addition of an eighth of an inch of a mixture of two parts of cement with one part of moistened fine sifted Kentish rag and Bath stones. The blocks thus formed are soaked in water and exposed to the action of the air to harden. The surfaces thus produced are harder and less slippery than natural or artificial stones otherwise prepared. The claim is made for the general method of manufacture, as above described.—C. C. H.

Improvements in the Manufacture of Portland Cement. J. W. Matteson, W. J. Chapman, and T. G. Matteson. Eng. Pat. 13,237, October 6, 1884.

THIS invention has for its object the improvement of the quality of the mixture of chalk, clay and water in cement making, technically known as "slurry," and the obtaining at a particular stage of the manufacture of a more complete admixture and homogeneity of the materials, with perfect disintegration, and free from small particles of chalk, hitherto met with in all all known processes of manufacture. The apparatus consists of a rotary sieve or "tempse," preferably of conical shape, revolving in a well provided with an exit pipe at one end. Around the exit a fixed flange is built into the masonry, and an iron disc at the end of the sieve revolves in contact with it. The slurry which has passed through the meshes of the sieve is further mixed and ground between the discs at the exit. To clean the meshes of the sieve a cam wheel is fixed upon the same, which causes a hammer to strike it repeatedly at each revolution of the machine, thereby shaking the obstructions out of the meshes.—H. J.

X.—METALLURGY, MINING, Etc.

On Japanese Bronzes. Dingl Polyt. Journ. 254, 138.

IN the Bavarian Museum of Industry at Nüremburg are eighteen Japanese bronze plates, remarkable for the excellence of their workmanship. According to G. Marquard, these plates consist of five distinct alloys, the composition of which is as follows:—

		Copper.	Tin.	Lead.	Zinc.	Iron.	Arsenic.
No. 1. Brass		73·28	—	0·79	25·71	trace	trace
No. 2. O	Mark of Alloy	72·60	4·0	11·74	11·48	0·21	
No. 3. O O		75·13	3·18	15·07	5·64	0·15	"
No. 4. C		82·17	3·96	13·31	0·28	0·21	"

No. 5. Copper (containing traces of Lead and Iron).

It will be seen that these alloys range from brass to pure copper.—E. G. C.

A New or Improved Process for the Treatment of Sulphurous and Arsenical Compound Ores containing Nickel, Cobalt, and other Metals. Benjamin J. B. Mills, Southampton Buildings, Middlesex. Communication from Pierre Manhès, Lyons, France. Eng. Pat. 5355, November 13, 1883.

THE ore mixed with suitable fluxes is fused in a cupola, or reverberatory furnace, to separate from gangue, and is then transferred to a converter, where it is submitted to the action of air, the "blow" being continued until 1 or 2 per cent. of iron and about 15 per cent. of metalloids remain. Further action would cause oxidation of nickel and cobalt. This matte, containing little else than nickel, cobalt, copper, sulphur, arsenic, and the above-stated quantity of iron, may be refined either by attacking with hydrochloric acid, and separation by any known wet method, by electrolysis, or by a second dry-refining process. The last-named process may be used to produce an alloy of the metals contained in the matte, and consists in again blowing air through the melted mass until the iron and sulphur have been oxidised, when the resulting product is reduced with carbon and lime, by which means the sulphur is completely eliminated. If the matte contain only nickel, sulphur, iron, and metals more oxidisable than iron, pure nickel will result from this treatment; otherwise the product may be granulated in water, and afterwards electrolised. A small quantity of nickel and cobalt pass into the slag during the lime-carbon reduction.—W. G. M.

An Improved Pot for Melting Metals. By John Harsant. Eng. Pat. 109, January 1, 1884.

THE improvement consists in placing a deflector ring of semi-circular section over the edge of the melting pot and a little distance above the edge, so that the flame and heated air passing up the sides of the pot are bent over the edge, and thrown downwards in the interior so as to play on the surface of the metal or other substances which are to be heated.—J. T.

Improvements in Gold Amalgamating. By B. C. Molloy, London. Eng. Pat. 143, January 1, 1884.

THE object of the invention is to prevent the sickening of the mercury employed in amalgamating gold and other metals, and to increase the contact between the mercury and the metals to be amalgamated. A typical arrangement of apparatus consists of a shallow box with porous bottom carrying a half-inch layer of mercury. A continuous band of linen or other material carried by two drums just dips into the mercury surface and is moved over that surface by the rotation of the drums. Beneath the porous bottom is a trough fitted with carbon, platinum, lead or other suitable anode, and containing a sufficient quantity of an aqueous electrolyte in contact with the porous bottom carrying the mercury. On connecting the apparatus with any suitable source of electricity giving an electromotive force of about four volts, and making the mercury layer the cathode, the hydrogen evolved, when a suitable electrolyte is employed, prevents the "sickening" of the mercury. The slimes to be treated are passed down an inclined shoot into the surface of the mercury, and by the motion of the endless band are carried closely in contact with the "quick"

mercury across the box. When dilute sulphuric acid is employed as electrolyte, the anode may be of lead; but when an alkaline electrolyte is used, an anode of carbon platinum is preferred.—J. T.

Treatment of Scrap Zinc. By A. K. Huntington and J. Humphrys, London. Eng. Pat. 224, Jan. 1, 1884.

THE scrap zinc is assorted and cut into small pieces, all iron, and pieces containing solder upon them being removed. After washing in hot water, which may contain a little alkali, the zinc is melted and cast into ingots. The pieces containing solder are also washed, melted, and allowed to cool slowly, the metals being separated as the mass cools. This melting and cooling can be repeated several times if necessary. The portion containing mostly solder may be melted again and the zinc separated from it by exposure to air or by poling with superheated steam. The portion containing mostly zinc may be treated as above described by repeatedly melting and slowly cooling. The dross produced in melting the zinc is treated by distillation, but the quantity of dress may be much reduced by introducing the pieces to be melted at a low level in the melting pot, passing them down a tube.—J. T.

Improvements in Blast and Cupola Furnaces. By J. Swain, Oldham. Eng. Pat. 914, January 8, 1884.

THE invention consists in making between the walls of the furnace a chamber extending from below or about the level of the tuyers to the upper part of the cupola; the gases in a highly heated state are forced through this chamber from the lower to the upper part of the cupola, and heat is thus imparted to the tuyers (which are laid in the chamber), and so the air for combustion which is forced into the furnace through the tuyers. In this chamber is sometimes placed chlorine or sodium chloride; the blast for the furnace forces the gases through the lower passages from the furnace into the chamber over the sodium chloride, from which fumes are raised, and these fumes with the other gases go from the chamber through the upper passages into the furnace at or about the point of fusion, and thus purify the metal and accelerate the fusion.—J. T.

Production of Yellow Metal. By T. Parker, Wolverhampton. Eng. Pat. 1223, January 11, 1884.

THE chief object of this invention is to produce economically a yellow metal of great tensile and compressive strength and hardness. This is effected by melting copper, 50 parts; spelter dross, 25-30; spelter, 12-17; tin, ½-2 parts, with a flux of the following composition made into a paste:—Salt cake, 5 parts; coal-dust, 5; silica, 15; bone ash, 20 parts. Manganese or copper sulphate, or the chlorides of these metals, and also common salt, may be used in place of the salt cake. This flux is also applicable to the founding of brass and bronze generally.—J. T.

Improvements in Regenerative Furnaces. By T. B. Massicks, Millom. Eng. Pat. 1261, January 11, 1884.

THE object of this invention is to improve the construction of furnaces for melting, puddling, or reheating steel, iron, etc., so as to obtain greater facilities for cleansing such furnaces, and removing the dust that accumulates in the regenerator, and also to obtain a more extended distribution of the gas and air employed in heating the furnace. These objects are effected by forming a separate connection for the admission of air to the furnace, and so preventing the air from passing through the joints of the brickwork and coming into contact with the gas as heretofore, until the moment when the air descends through the roof, when it comes into contact with the gas issuing from the regenerator, thus the greatest intensity of heat is obtained at the point where it is most needed. The gas issuing from the regenerator is conducted through a number of passages inside the furnace, and extending the whole width of it or nearly so. Air is conducted from the regenerator through a suitable tube at the end of the furnace to an opening formed in the roof of the furnace, preferably at either end; this opening is covered with a loose top or casing with an enlarged semi-circular or suitably shaped end; this loose top may be removed at any time for cleansing purposes or repairs, without interfering with or stopping the furnace. The usual reversing arrangements and regenerators are employed, and suitable cleaning doors are fitted in the gas passages leading from the regenerator.—J. T.

Manufacture of Phosphates. S. Gilchrist Thomas, London. Eng. Pat. 1341, January 12, 1884.

HIGHLY phosphoric molten iron is poured on hydrated or carbonated alkali, and the whole is maintained at a high temperature in presence of air on the basic or neutral hearth of a Siemens gas furnace or a converter. Special provisions are detailed for preventing loss of alkali by volatilisation. The resulting slag consists essentially of alkaline phosphate suitable for use as a manure or for the preparation of the crystallised salt. —G. H. B.

Manufacture of Alkalis, Phosphates, etc. S. Gilchrist Thomas, London. Eng. Pat. 1342, January 12, 1884.

THE foregoing process is extended by the use of common salt instead of alkali, and the reaction is facilitated by admitting superheated steam with the air blast. The production of chlorine, hydrochloric acid and sodium phosphate is thus effected, and these substances are recovered in a suitable way.—G. H. B.

Manufacture of Alkaline Silicates. S. Gilchrist Thomas, London. Eng. Pat. 1343, January 12, 1884.

AN extension of the two preceding processes in which highly siliceous pig iron is caused to act on alkaline chlorides at a high temperature in presence of air and steam for the production of chlorine, hydrochloric acid and alkaline silicate.—G. H. B.

An Improved Method or Process of Extracting Aluminium from Substances containing the same. William Robert Lake, Southampton Buildings, London. Communication from Fredk. J. Seymour, Wolcotville, Connecticut, and Wm. Hy. Brown, New York, U.S. Eng. Pat. 1639, January 17, 1884.

THE aluminous ore (kaolin has yielded the best results) after drying and crushing, is mixed with an ore of zinc—preferably calamine—which has been roasted to remove sulphur and pulverised, together with carbonaceous matter and suitable fluxes. The proportions recommended are: Kaolin, 60 parts; zinc ore, 60 parts; carbonaceous matter—*e.g.*, a mixture of equal parts bituminous coal and willow charcoal—120 parts; and common salt, 3 parts. This mixture is introduced into cylindrical retorts, of fire-clay or of cast-iron lined with clay, which are then closed by conical stoppers, each of which is provided with a very small aperture at the apex. These retorts are arranged in a suitable furnace chamber, heated by a coal fire. The reduction of the aluminium is facilitated by the presence of the zinc with which it forms an alloy. When the metal flows freely the stoppers are removed, and the alloy is tapped. The alloy is to be used as such, or to be separated by distillation, or by gravity (aided by a "jigging" motion), the heavier zinc sinking to the bottom.—W. G. M.

Treating Ores or Scoria containing Copper or Nickel. By J. H. Johnson, London. Communicated from E. Hermite, Rouen. Eng. Pat. 2157, January 25, 1884.

THE ores or scoria, containing copper or nickel, are reduced to a fine powder and placed in a rotating vessel. A solution of ammonia is introduced into the vessel, the

amount of ammonia being regulated according to the richness in metal of the ore or scoria, and the air is then compressed to a pressure of from about three to four atmospheres. The vessel is then rotated for from about thirty to sixty minutes according to the nature of the ore. After settling, the liquid is decanted; the ore is washed again with a fresh supply of liquid if required, and finally with water, but always under pressure. The liquid obtained above, is subjected to electrolysis in iron vessels containing cathodes of cast-iron and anodes of carbon. A small quantity of caustic soda or potash may be added to the liquid to render it a better conductor. The copper or nickel deposited is afterwards run into ingots.—J. T.

Malleable Ferro-Nickel and Ferro-Cobalt and their Alloys. A. M. Clark, London. Communicated by the Société Anonyme dite Fonderie de Nickel et Metaux Blancs, Paris. Eng. Pat. 2573, February 1, 1884.

This invention relates to the manufacture of malleable ferro-nickel and ferro-cobalt, by the direct employment of pigs or mattes of these metals (without that part of the subsequent refining which would have for object the elimination of the iron), which are combined at one and the same fusion with ferro-cyanide, or potassium cyanide, and one of the oxides of manganese (binoxide, for example), adding, at the moment of running, a small quantity of aluminium. The pigs to be utilised are obtained by the simultaneous fusion of ores of nickel and cobalt, nickel and chromium (chrome iron ore), cobalt and chromium, or of nickel cobalt and chromium, using pure ores of nickel or cobalt with the addition of oies of chromium when the products are to contain a small percentage of nickel or cobalt and a large percentage of iron; all these pigs or mattes, whether simple or mixed, containing a low percentage of sulphur, are what it is intended to utilise, with or without an addition of soft or crude iron. These alloys, fused with the cyanide as above, are rendered permanently malleable even after a second fusion, and are adapted for casting, rolling, drawing, wire-drawing, and hammering. Whilst soft iron loses, by a second fusion, its fibrous texture and becomes crystalline and brittle, this same soft iron preserves its malleability after the second fusion, if it had been previously mixed with a certain quantity of the malleablised products above described.—J. T.

Separation of Lead from Precious Metals. By E. H. Russell, Park City, U.S.A. Eng. Pat. 5430, March 25, 1884.

In the ordinary process of leaching metals from ores by chemical solutions, the compounds of silver and gold are extracted by being dissolved out with a solution of hyposulphite of an alkali or alkaline earth. The sulphate and chloride of lead, however, are often present in the ores, and are likewise soluble in the hyposulphite solution. This dissolved lead contaminates the bullion produced, and necessitates expensive refining operations. The author finds that the addition of a soluble carbonate to the hyposulphite precipitates the lead alone and leaves the silver, gold and copper that are present in the solution unprecipitated. The process is intended to be used particularly upon ores or products which have been previously subjected to a chloridising roasting, but it is also applicable to some raw ores in which the precious metals exist in forms soluble in hyposulphite solution.—J. T.

Improvements in Processes and Apparatus for Converting Iron or Making Steel. Thomas Williamson, Wishaw, Lanarkshire. Eng. Pat. 6082, April 8, 1884.

This invention consists in a combination of the Bessemer and Siemens processes. The converter is of somewhat different shape to that now in use, the tuyeres delivering the gas not in the direction of the main vertical axis of the vessel as usual, but tangentially to circles having their centres in the trunnion axis; the mouth of the converter is diagonally opposite to the tuyeres, and is closed with a luted cover during the blow. The gases, on account of the position of the tuyeres, pass spirally round the trunnion axis, thus depositing much of the iron and slag carried with them, and thence through the trunnions themselves, which are hollow and of considerable diameter, to regenerative chambers. The trunnions rest on roller-bearings, and are connected with the regenerators by a water-cooled joint. The air is conveyed from the blowing engine by a fixed main, and thence through jointed tubes to the tuyere-box. In use, the converter is turned down, by worm-wheel or spur-wheel teeth on one of the trunnions gearing with a worm or pinion beneath, and charged in the usual way; the cover is then luted on, the vessel turned up, and the blow started and continued for ten or fifteen minutes; it is then lowered and the blast shut off, and air and gas are passed through the regenerators, the remaining operations being carried on and completed as in a Siemens furnace. The cover is removed from the converter-mouth, which then serves the purpose of a working-door. The metal is tapped by turning the converter down, as in the Bessemer process, the slag being afterwards removed by inverting the vessel. Acid or basic lining may be employed, but the patentee prefers the former.—W. G. M.

Amalgamating Apparatus. By. A. Miller, London. Eng. Pat. 9151, June 18, 1884.

A U-shaped vessel is provided, the one limb being preferably larger in sectional area than the other. This vessel is charged with mercury when the amalgamation is to be carried on in the cold, or with with molten lead or other suitable metal, when the operation is to be carried on at a high temperature, and in that case the apparatus is placed over a fire or in a flue to keep its contents hot. Near the mouth of the smaller limb is placed a lateral feed aperture, surmounted by a hopper containing the ore or tailings to be treated. The material can be carried into the vessel from the hopper either by a screw or a plunger. The charge is thus pushed into the limb and is caused to descend, rising again through the mercury or molten metal in the larger limb. Both limbs are clossd at the top and have mounted centrally within them vertical shafts, canying several sets of inclined blades. In the smaller limb there are several grids, and at the bottom of the larger one is also fixed a grid. In the latter limb there are several fixed blades to keep the contents from rotating. At the top of the wide limb there is a lateral opening for discharge of the spent material. Also at the bottom bend there is a passage for drawing off the amalgam.—J. T.

An Improved Manufacture of Sheet Metal from Lead, Tin and other similar Metals or alloys thereof, and Apparatus used for that purpose. Chas. Denton Abel, Southampton Buildings, London. Communicated by Reinhard Poensgen, Dusseldorf. Eng. Pat. 9910, July 8, 1884.

This is a method for "squirting" metal plates. The melted metal is run into a cylindrical chamber with an accurately-fitting vertically-sliding floor actuated by a series of hydraulic rams; on raising the floor, the metal is forced between two sets of movable cheeks, the distances between which may be accurately regulated by means of hand-wheels and screws, according to the width and thickness of plate required. These cheeks or dies are situated at the top of the chamber, and allow the solidified metal to pass out in an uninterrupted sheet of the precise dimensions desired.—W. G. M.

Improved Refractory Substance. J. H. Johnson, London. Communicated from abroad by Messrs. J. B. Mallion and Son, Turin. Eng. Pat. 9917, July 8, 1884.

This invention consists in the preparation of crucibles, retorts, etc., of magnesia. Magnesia free from foreign matters is employed, which may be obtained by roasting

magnesite, gisbertite, periclase, or other minerals or compounds of magnesia, but it is preferred to employ magnesia obtained from sea-water in order to obtain a product chemically free from silica. A suitable quantity of this material, made into cakes, is roasted at an intense temperature, and the product thus obtained is coarsely ground. Another quantity of the magnesia is maintained in a caustic condition, and the two products thus obtained are mixed together according to the purpose to which they are to be applied in the proportion of from about 60 to 90 per cent. of the roasted magnesia, and from about 10 to 40 per cent. of the caustic magnesia. The proportion is, however, varied according to the purpose to which the product is to be applied. This mixture is moistened with water containing starch, flour, potassium carbonate, or other binding material, and is well rammed into moulds. The objects thus obtained, after being dried, are ready for use, but in some cases it is desirable to expose them to a high temperature, preferably not less than that of a Siemens-Martin gas furnace.—J. T.

Improvement in Tuyeres used in the Manufacture of Iron and Steel. Christopher Thompson, Sunderland, Durham. Eng. Pat. 10,292, July 18, 1884.

THE improvement consists in piercing the tuyeres of converters or furnaces with thin broad passages, tapering slightly towards the outlet, instead of with the circular channels usually employed. The advantages claimed are: That fewer tuyeres are necessary for passing a given quantity of gas, and hence a saving in their consumption; that there is less friction between the air and the walls of the passages, so that less blast-pressure is needed; that as the tuyere wears away to the enlarged part, more air will pass, and will thus give warning of the fact; that some of the difficulties connected with fixed converters are removed, and that in moveable converters, horizontal blowing may be successfully employed, which will prevent metal from being blown out of the mouth; and, moreover, the scouring action of the molten metal will take place on the more refractory converter-bottom, instead of on the plug and tuyeres, and greater uniformity of pressure will also result; that a greater charge than heretofore may be worked off in any given converter, and the blast-box and tuyeres are smaller and lighter, and the plug and tuyeres less acted upon, whilst repairs are more readily effected.—W. G. M.

Improvement in Tuyeres used in the Manufacture of Iron and Steel. Christopher Thompson, Sunderland, Durham. Eng. Pat. 10,574, July 25, 1884.

IN order to lessen the friction of the air passing through the converter tuyeres, and to cause due notice of their wearing away, and of the consequent dangerous approach of the molten charge to the tuyere plate, by the increased volume of air passing, the patentee enlarges the circular perforations at the inlet end to a depth of from 5 to 7 inches. The tuyeres may be made in the moulds commonly used, the piercing rods alone being different.—W. G. M.

Treatment of Ores containing Antimony Sulphide. By J. Simpson and E. W. Parnell, Liverpool. Eng. Pat. 11,827, September 1, 1884.

PULVERISE the ore to pass through a forty-mesh sieve and add it to an aqueous solution, preferably hot, of a fixed alkali, of a fixed alkaline sulphide, or of a sulphide of the metal of an alkaline earth. The decanted solution is treated with just sufficient hydrochloric acid or other cheap acid to precipitate the antimony sulphide. Instead of acid being employed, air may be passed into the solution, or the solution may be evaporated to dryness and the resulting compound further treated. The authors find that ore of the fineness indicated above readily dissolves in sodium sulphide solution of about 40° Tw. or in calcium sulphide of about 10° Tw.—J. T.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Treatment of Mineral Oils in Combination with other Matters, and Producing therefrom Soap, Candles, and other Articles. W. Green, St. Lawrence. Eng. Pat. 5954, December 31, 1883.

THE inventor refers to letters patent previously granted to him, and dated June 18, 1881 (2682), and September 5, 1882 (4226). According to the present invention, the lighter portion of the mineral oil under operation is recovered, and the whole of the remaining portion is saponified or combined with the soap being made, so that on cooling, no oil rises to the surface of the soap. Various distinctive processes are to be adopted, according to the kind of soap required, the mineral oils being brought into a state of fusion, or semi-fusion, with an alkali; also with castor oil, and other oils and fats, and with resinous, gummy and other matters. Each process will admit of considerable modification, according to circumstances.—E. G. C.

XII.—PAINTS, VARNISHES, Etc.

Improvements in Obtaining Compounds of Lead suitable for Making Pigments and for other Purposes. A. French. Eng. Pat. 5193, November 1, 1883.

THIS invention relates to the treatment of sublimed white lead, or the compound obtained by a process described in a previous specification of letters patent granted to the inventor on June 8, 1881 (2494). In order to obtain "an excellent white pigment requiring very little oil to form white paint, of the consistency of ordinary white lead," the sublimate (formed in the working of the inventor's process), consisting principally of sulphite of lead, is treated with hydrochloric acid, an oxychloride being produced. To obtain a dark red or brown pigment, consisting of peroxide of lead, and a "sulphur compound of lime," a strong solution of bleaching powder is prepared, and the sublimate is gradually added to it with brisk agitation. The chlorine gas evolved may be passed into chambers containing lime, so as to recover the gas as chloride of lime; or it may be made use of in any other way. —E. G. C.

Anti-fouling Composition Suitable for Ships' Bottoms and other Submerged or Partly Submerged Structures. W. F. McIntosh and W. S. Crondace, Dundee. Eng. Pat. 5330, November 12, 1883.

THIS invention consists in compounding and boiling together Venice turpentine, tallow, colcothar and Palma Christi oil, with a mixture of barium sulphate and calcium carbonate ground with linseed oil and common turpentine. Various proportions of these constituents may be used, but the following quantities have been found to answer well:—

Venice turpentine and common turpentine	3	per cent.
Linseed and Palma Christi oil	4	" "
Tallow	40	" "
Colcothar	12	" "
Barium sulphate	20	" "
Calcium carbonate	20	" "
Alumina	1	" "

The mixture is applicable to ships' bottoms, buoys, floating docks, dredgers, bridge and lighthouse piers, or submerged or partly submerged structures made of iron or steel; and it is heated and applied while hot, over one or more coatings of zinc or white lead paint, preferably the former.—E. G. C.

Improvements in Compositions for Ships' Bottoms, and in the Method of Applying the same. W. Day, Blackheath. Eng. Pat. 267, January 2, 1884.

THE inventor first applies to the inside and outside plates of ships, caissons, water tanks, etc., a preparatory coating of crude spirits of naphtha. When the spirit is partly absorbed into the pores of the surface, a second

coating of the following composition is applied. A solution of India-rubber in naphtha is added to a mixture of melted rosin and tar, the proportions of these ingredients being, in general, an ounce of India-rubber, four pints of crude spirits of naphtha, four pounds of rosin, and two pints of coal-tar. To this mixture are added a pound of granulated pitch and a pound of Portland cement, lime, or other similar powder. The last-named ingredient may be omitted, but then the composition has less body. The composition is put on with a brush. When desirable—*e.g.*, for the inside bilge bottom plates and rivet heads of ships—a third coating or layer, consisting of hot asphalte, may be applied in addition.—E. G. C.

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Improvements in Paints or Compositions for Coating Ships' Bottoms and other Submerged Surfaces, and for Preserving Iron, Wood, etc., from the Effect of Atmospheric Exposure. G. J. Andrews and J. E. Sutton, London. Eng. Pat. 5996, April 5, 1884

Two ounces of litharge and 90gr. of mercuric chloride are mixed with a gallon of raw linseed oil, the mixture being gently boiled until the salts are quite dissolved. Four pounds of bitumen and four pounds of the best black pitch are now added, a gentle heat being again applied until the whole is dissolved. When the mass is cold, three pounds of dry red lead is added, and, finally, sufficient spirit of turpentine "to form a good working paint," which paint is to be applied in any ordinary way to the surface to be coated. In certain cases no turpentine need be used, the composition being liquified by heating and applied while hot.—E. G. C.

XIV.—AGRICULTURE, MANURES, Etc.

The Estimation of Nitrogen in Commercial Manures. By P. Wagner. Chem. Zeit. viii. 37, 649.

For the estimation of the nitrogen in ammonia salts the author recommends the use of the azotometer, which is fully described in his "Lehrbuch der Dünger-Fabrikation." The use of about four liters of cooling water is recommended and care should be taken to keep the whole during the experiment at a constant temperature. For the estimation about 20grm. of ammonium sulphate, or 40grm. of ammonium- or potash-ammonium superphosphate, should be taken, mixed in a liter flask with distilled water, and well shaken for half an hour; the solution is then filtered, and 10cc. of the filtrate introduced into the azotometer. The weight of nitrogen found (in grammes), multiplied by 500, when 20grm. of sub. are used, and by 250 if 40grm. are taken, gives directly the percentage of nitrogen. For the estimation in organic substances the author makes use of the soda-lime process. As he has already recommended in a former paper (*Chem. Zeit.* vii. 1475), he uses an iron combustion tube, not only on account of the cheapness and greater ease it affords, but also because it allows of better and more exact results being obtained. It has often been observed that such substances as leather or blood-powder give but very indifferent results with the soda-lime process. The author has always obtained good results with such substances, as the following figures show:—

Sub. Used.	Nitrogen.	Difference from Average.
0·5	13·16	0·13
—	13·16	0·13
—	13·02	0·01
—	13·09	0·06
0·6	12·95	0·08
—	12·89	0·014
0·75	12·92	0·11
—	13·02	0·01
—	13·16	0·13
—	12·97	0·06
0·5	13·09	0·06
0·5	12·95	0·08
Average	13·03	

The following is the complete apparatus used (Fig. 1). It consists of an apparatus for generating hydrogen, a gasometer, and combustion tube with accessories; A is a bell-jar 67cm. high and 10cm. wide, hung in a cylinder 18cm. wide and 65cm. high, filled with dilute sulphuric acid. The bell jar is closed at the bottom with a perforated lead plate, which rests on two glass rods placed in perforations in the glass; above the lead plate is a layer of fine gravel 13cm. thick, and the rest is filled with granulated zinc. On opening the screw-cock, acid ascends into the bell-jar, the generated hydrogen passing through the U-tube, which is filled with soda-lime, on its way to the gasometer, the construction of which will be clear from the drawing. It is only necessary to remark that the cylinder is weighted with lead at the top to obtain the necessary gas pressure. The wash-bottle D is half-filled with water, enabling the gas stream to be observed and regulated by the screw-cock C. The combustion furnace needs no description. The wrought-iron tube which is used is 95cm. long and 17mm. wide, and projects 17cm. in front of and 25cm. behind the

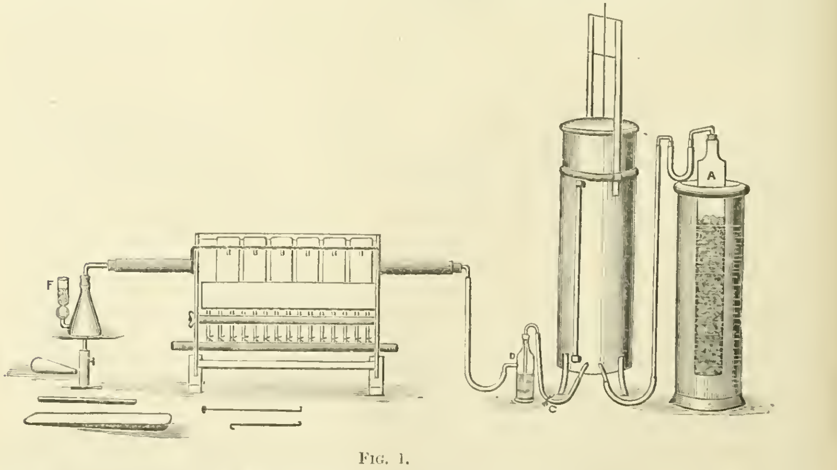
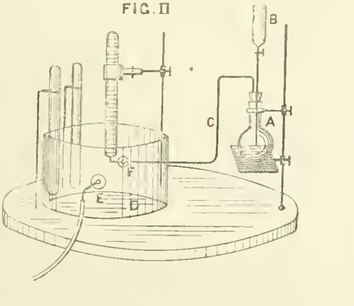


Fig. 1.

furnace. The ends are closed with India-rubber corks; in the front part of the tube, about 15cm. from the mouth, is placed a 12cm. long layer of coarse and not fused soda-lime held together in front by an asbestos wad, and behind by a piece of iron wire gauze rolled together. This tube will serve for about 100 combustions. The flask G is used to contain the titrated acid which is poured in by way of F, and some part of which is retained by the glass-worl placed there for that purpose, so that no trace of ammonia can pass through. The following is the method used for titrating the excess of acid: A few drops of rosolic acid are brought into G, and soda solution added until red colour is produced, the liquid is then poured into a porcelain basin, then through F back into G, then again into the porcelain dish, and the titration finished; the titrated liquid is then poured through again, and if necessary soda solution added until the reaction is permanent. Should, on account of a colouration of the acid, the colour reaction not be clear enough, a drop or two of acid is added to the titrated liquid, it is then evaporated to dryness on the water bath, and the residue brought with the aid of 10cc. of water into the azotometer. With regard to the filling of the combustion tube, the following is to be said. The substance is mixed in a mortar with powdered soda-lime, and emptied into the copper capsule H, from which it is easily brought into the 31cm. long iron boat I, which, during the operation of filling, is laid in the 3½cm. wide copper plate K, thus preventing any loss of the mixture. After the mixture is covered with soda-lime, which has been used for cleaning the mortar, etc., of any mixture that may have clung to it, the iron boat, with the aid of the wire L, is pushed into the combustion tube, the end of which is again closed with the India-rubber cork, the other connections made, and a slow stream of hydrogen passed through, which is kept up during the whole time of the combustion. The tube is heated in the usual manner. The end of the combustion can be readily ascertained by pinching the India-rubber tubing with the fingers, near the screw-cock C, and observing if the acid in G retains its level. If this is the case the gas is turned off, the flask G changed, and the iron boat, as soon as red heat has disappeared, withdrawn by the aid of the wire N, a fresh boat placed in the still hot tube, and a fresh combustion commenced. A chemist with the aid of two furnaces can readily complete 25 combustions a-day. The author now goes on to the estimation of the nitrogen in nitric acid, refers to his former paper (*Chem. Zeit.* vii. 1710), and gives the

FIG. II



following explanation of the apparatus he uses. A is a Berlin flask of 250cc. to 300cc. capacity; B a funnel tube with stop-cock, of about 15cc. capacity, reaching to the centre of the flask, but not touching the liquid in it; C is a glass tube that reaches to the 24cm. wide, 18½cm. high trough D, and which ends below the water level. The opening E of the trough D is for the purpose of conveying fresh water to the trough, and F, which is provided with a tube that reaches 2cm. higher than C, is for the exit of the water. A wire frame is provided for holding the etched tubes. Fig. 3 represents a cylinder 44cm. high and 14½cm. wide, to receive the etched tubes, after being filled with nitrous oxide. The experiment is conducted as follows: 40cc. of a solution of ferric chloride (containing 200grm. of iron in the liter) is brought with an equal quantity of HCl (20 per cent.) into the flask A. Several cc. of HCl are then placed in the funnel B, the cock opened and the HCl allowed to flow into the flask, care being taken to retain several drops in the funnel, to prevent the admission of air into the flask, the contents of which are then boiled until all the air is driven out. As soon as that is accomplished 10cc. of "normal saltpetre solution" (which contains exactly 33grm. of pure nitrate of soda in the liter, are placed in the funnel and allowed to flow drop by drop into the boiling iron solution. The normal solution is washed through with 20 per cent. HCl, and when this has run through the operation is complete. The etched tube is then changed, the iron solution being kept boiling, and 10cc. of the solution to be analysed (which must be made of such strength as to evolve 50cc. to 90cc. of nitrous acid during the operation) placed in the funnel and allowed to run through in the same way as the "normal solution," it also being washed through with 20 per cent. HCl. The iron solution is sufficient for seven or eight estimations. The graduated tubes having been conveyed to the cylinder before mentioned, which is filled with water of any convenient temperature, the volume of nitrous acid can be read off without the necessity of observing the temperature or the barometer pressure. The calculation is very

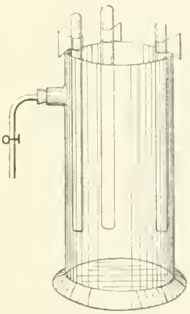


FIG. III

simple. Grandeau has prepared a table so that one has only to read off the volume of gas. To prepare the test solution 33grm. of the substance are to be taken and dissolved in a liter of distilled water, and so much of the filtrate taken as evolve at least 50cc. of gas. The results are very exact and reliable, the operation being at the same time very simple. Besides the above methods the author has found Ruffle's method for the analysis of Peru guano very convenient, and recommends the following modifications: Mixture I. is made of 100 parts by weight of powdered soda-lime, with 10 parts of oxalic acid. Mixture II., 100grm. caustic lime with 10cc. pure concentrated H_2SO_4, the mixture to be preserved in a well-stopped bottle. Mixture III., 100 parts by weight of hyposulphite of soda, dried on the water bath, are mixed in a warm mortar with 100 parts dried soda-lime, eight parts powdered wood charcoal, and eight parts of flowers of sulphur. The mixture is to be poured, still warm, into a flask, the mouth of which is to be closed with an India-rubber cork. For the experiment a 5cm. long layer of mixture I. is brought into a glass tube, 40cm. long and 8mm. wide, closed at one end. Then 1·5gr. of an equal mixture of Peru guano and mixture II., are mixed with 20gr. of mixture III., and the whole brought into the tube, which is then filled with coarse soda-lime. The rest of the operation is conducted in the usual manner.—F. T. S.

Report on a Series of Experiments carried out in 1882 at the Kiel Agricultural Station. Prof. Emmerling, Dr. Loges, and Dr. Metger. Biedermann's Cent.-Blatt. 1884, 4, 217.

These experiments furnish information as to the influence on different soils of soluble and precipitated phosphoric acid in combination with nitrogen, of bone-meal, Peruvian guano, etc. The report contains a long and detailed account of these experiments, together with tabular statements of the various manures employed, their composition, the constitution and nature of the different soils, and the character of the crops obtained. —E. G. C.

On Sulphuric Acid as a Manure. H. Fresenius, Stocks, and an unknown Author. Biedermann's Cent.-Blatt. 1884, 3, 160.

The first-mentioned author considers that, as a rule, sulphuric acid scarcely exercises any influence at all as a manure: only in a soil free from lime and rich in phosphoric acid could it effect the liberation of the latter. Stocks has made some experiments with rye, wheat, and barley, and has shown that, while sulphuric acid appears to induce a very slight increase in the crop, its cost is so considerable that its use is anything but profitable. The third author's observations coincide entirely with those of Dr. H. Fresenius. The concensus of opinion, therefore, seems to be against manuring directly with sulphuric acid.—E. G. C.

Manuring Barley and Oats with Nitrogen and Phosphoric Acid. Dr. M. Märcker. Biedermann's Cent.-Blatt. 1884, 3, 162.

Dr. Märcker's experiments indicate that nitrogenous manures used alone, such as Chili saltpetre, promote the growth of oats far more than that of barley. On the contrary, phosphatic manures are eminently favourable to the growth of barley, while their effect in promoting the growth of oats is but moderate.—E. G. C.

On Crude Ammonium Superphosphate as a Manure. Dr. E. Wollny. Biedermann's Cent.-Blatt. 1884, 3, 167.

The ammonia contained in lighting-gas has hitherto been absorbed in sulphuric acid, and brought into the market as ammonium sulphate. According to a new process, that of Bolton and Wanklyn, the gas freed from tar is passed into holders containing superphosphate spread on trays. The superphosphate absorbs the ammonia, a dark green or black neutral substance of a penetrating odour being thus formed. This crude ammonium superphosphate contains, according to H. Bunte, 7·5% of ammonia, and the phosphoric acid is present in it in the precipitated condition. Dr. Wollny's experiments were made with the object of ascertaining the value of the crude superphosphate as a manure, and of settling the question whether the ammonium thyocyanate contained therein would be prejudicial to vegetation. Crude ammonium superphosphate, prepared by Bolton and Wanklyn's process, contains 0·7 to 1·0% of ammonium sulphocyanate; and the author found that this compound, when used in quantity amounting to 500kg. per *ha.*, exercised the same influence on the crops as ammonium superphosphate, free from sulphocyanate, but containing the same amounts of nitrogen and phosphoric acid. The prejudicial effect of the ammonium sulphocyanate only becomes marked when more than 500kg. per *ha.* of the impure superphosphate (containing the above-mentioned quantity of sulphocyanate) is employed, and it is observed to vary with different cereals.—E. G. C.

On the Value of "Markkohl" as Fodder. Dr. Adolf Mayer. Biedermann's Cent.-Blatt. 1884, 3, 170.

Analyses of the stalks and leaves of the three kinds of cabbage, known as green "markkohl," "red markkohl," and ordinary cabbage, furnished the following results:—

1.—Stalks.

	Green.	Red.	Ordinary.
Water	87·0	86·7	86·3
Albumen	0·9	0·7	0·7
Other nitrogenous substances	0·3	0·5	0·5
Fat	0·2	0·2	0·3
Carbohydrates	7·9	7·9	8·7
Cellulose	2·4	2·4	2·6
Ash	1·3	1·6	0·9
	100·00	100·00	100·00

2.—Leaves.

	Green.	Red.	Ordinary.
Water	87·0	87·0	86·5
Albumen	1·7	1·5	1·6
Other nitrogenous substances	0·8	0·7	0·0
Fat	0·5	0·4	0·6
Carbohydrates	6·9	6·5	8·2
Cellulose	1·5	1·6	1·1
Ash	1·6	2·3	1·2
	100·00	100·00	100·00

Taking the relative values of albumen, fat, and carbohydrates as being 5 : 3 : 1, the following figures, expressing the nutritive values of the three kinds of cabbage, are obtained:—

	Green.	Red.	Ordinary.
Stalks	12·0	11·0	12·1
Leaves	16·9	15·2	18·0

—E. G. C.

Experiments with Potatoes, Beetroots, and Maize, carried out at the Agricultural Station of the Somme. A. Nantier (Annales Agron. 1882, 9, 193-206). Biedermann's Cent. Blatt. Agrik. Chem. 10, 662.

The soil chosen was of moderate productiveness, and an average sample yielded, on analysis, the following results:—

Siliceous pebbles, over 5mm.	25·65
" " from 3 to 5mm.	2·15
" " " 1 to 3mm.	1·60
Fine earth, under 1mm.	70·60
	100·00

The air-dried fine earth gave:

Water	6·93
Nitrogen	0·20
Phosphoric acid	0·25
Humus	1·06
Carbon contained therein	0·61
Potassium	0·10
Lime	5·97

Although this ground cannot be called poor, as regards its percentage of constituents valuable to plant life, it nevertheless, according to the author, contains only one third of the quantities which a good soil should contain.

Experiments with Potatoes.—These were made with four foreign and one German variety. The unmanured portions yielded the following results per *ha*, for every 1000 kilos. planted:—

Varieties.	Yield in Bulbs.				Containing.		Per *ha.*	
	Healthy.	Large.	Small.	Diseased.	Dry Substance.	Starch.	Dry Substance.	Starch.
	kilos.	kilos.	kilos.	kilos.	%	%	kilos.	kilos.
Saucisse (native)	2,600	1,710	860	660	21·6	11·5	639	377
Snowflake	2,858	1,608	1,250	112	25·8	18·0	731	540
Early Rose	4,200	2,500	1,700	100	26·2	17·5	1,099	693
Merveille d'Amerique	5,200	3,800	1,400	1,100	22·7	11·6	1,178	760
Champion	11,800	9,100	2,600	100	30·7	19·0	3,630	2,221

The unfavourable weather of the year in which the experiments were made, had a bad influence upon the results, the yield being only very moderate, and the number of diseased potatoes amounting to as much as one-fifth of the entire crop of two of the varieties—the Saucisse and the Merveille d'Amerique. It is evident, from the table, that in every particular the Champion variety furnished the most satisfactory results; those yielded by the Early Rose were also very respectable. Several parcels of the Snowflake variety were planted, and differently manured; they were given, in stable manure and peat, 140kg. of nitrogen; in Chili saltpetre and sulphate of ammonia, 70kg. of nitrogen; in the phosphates, 60kg. of phosphoric acid; and in potassium salts, 45kg. of potassium; in each case per *ha.* The following results were obtained:—

Manure, Kg. per *ha.*	Yield in Bulbs.			
	Total.	Large.	Small.	Diseased
	kg.	kg.	kg.	kg.
Unmanured	3000	1608	1250	142
Stable Manure ......35,000kg.	2856	1466	1230	160
Peat ....12,500 ,,	3440	2410	990	40
Chili Saltpetre.......... 450 ,,	3300	2000	1010	290
Ammonium Sulphate... 366 ,,	3040	1910	1030	100
Natural Phosphate .... 370 ,,	2750	2100	590	60
Precipitated Phosphate 300 ,,	4040	3554	470	16
Superphosphate .... 400 ,,	4090	3380	608	96
Potassium Salts	2108	1150	908	40

The most noteworthy results are evidently those with the precipitated phosphate and the superphosphate.

Experiments with Sugar Beets.—Two kinds were tried, "Rémy" and "Vilmorin." These varieties were similar to one another, and equally good. The results, with various manures, were as follows:—

Manure per *ha.*		Nutriment in the Manure.	Rémy.			Vilmorin.		
			Yield.	Sugar per cent.	Sugar per *ha.*	Yield.	Sugar per cent.	Sugar per *ha.*
Unmanured		—	kg. 28,200	11·7	kg. 3,299	kg 29,200	11·8	kg. 3,442
Stable Manure ....35,000kg.	Nitrogen.	140	34,000	11·0	3,740	34,300	11·5	3,910
Peat ....12,500 ,,		140	22,200	11·7	2,597	27,400	11·9	3,260
Chili Saltpetre...................... 900 ,,		140	35,800	11·4	4,081	39,800	11·7	4,616
Ammonium Sulphate............. 732 ,,		140	36,000	11·4	4,068	30,600	11·6	3,549
Superphosphate.................... 740 ,,	Phosph. Acid.	120	45,100	11·3	5,085	49,200	11·4	5,608
Precipitated Phosphate........... 600 ,,		120	45,600	11·2	5,060	48,510	11·6	5,626
Natural Phosphate .... 800 ,,		120	20,300	12·9	3,121	20,320	12·0	2,441
Potassium Salts.................... 200 ,,	Potassium.	90	28,000	10·6	2,968	29,200	10·2	2,978

Here, as in the case of the potatoes, superphosphate and precipitated phosphate furnished the best results, proving that the soil was wanting in phosphoric acid; this could be best added in the form of precipitated phosphate.

Experiments with Maize.—In consideration of the poverty of the soil, and the vigorous growth of maize, larger quantities of the manures were employed. The results per *ha.* were:—

Unmanured	30.000 kg.
Peat, 33,000kg.	24.500 ,,
Potassium Salt, 200kg..................	29,200 ,,
Potassium Salt, 100kg. (Peat, 16,500kg.)	26,000 ,,
Chili Saltpetre, 1200kg.................	36,200 ,,
Stable Manure, 50,000kg................	50,000 ,,

—E. G. C.

Experiments on the Influence of Feeding with Ground Cotton Cake upon the Yield of Cows' Milk. Biedermann's Cent.-Blatt. Agrik.-Chem. 10, 683.

The results of this series of experiments, which need not be given in detail, were communicated to the Agricultural Society of Oldenburg (*Journ.* 1883, 10, 91). On the whole they were decidedly in favour of this mode of feeding.—E. G. C.

Manuring with Fish (Landw. Wochenbl. Schleswig-Holstein, 21, 214). Biedermann's Cent.-Blatt. Agrik.-Chem. 10, 703.

This is carried out to a large extent in Western Holstein. Small herrings, smelt, etc., are carefully spread on the ground, both in the spring and autumn, and at once ploughed under; crows and sea-gulls carry away considerable quantities. This kind of manure can be applied to fruits, with satisfactory results; potatoes, however, are found to be watery and poor in flavour. The amount of fish used in Holstein for the purpose of manuring, varies very greatly according to the quantity caught. —E. G. C.

On the Estimation of Reduced Phosphoric Acid. Gassend and Campredon (Ann. Agron. 1883, 266-269). Biedermann's Cent.-Blatt. 10, 708.

The authors state that, in determinations of phosphoric acid (as ordinarily carried out, by precipitation with magnesia-mixture, ignition of the precipitate, and weighing the pyrophosphate obtained), the results come out 1 per cent. and more too high, the reason being that the precipitate is, under the ordinary conditions, impure, containing, according to the authors, alumina, oxide of iron, lime, magnesia, sulphuric acid, and especially silicic acid. Washing with dilute ammonia will effect the removal of all these impurities, with more or less difficulty, with the exception of the last, which can only be partially got rid of. It is therefore recommended that the precipitate be dissolved in acetic acid and the phosphoric acid titrated with uranium solution.—E. G. C.

The Value of various Nitrogenous Compounds for Manuring Purposes, and their Influence on the Composition of Oats. Dr. M. Maercker. Biedermann's Cent.-Blatt. 9, 584.

Seyffert made some experiments with turnips, which were grown in boxes, 1 square metre in size, and filled with sand. The plants received equal quantities of manure, the nitrogen being in different forms, and the results obtained were as follows:—

With manure free from nitrogen	75·5grm. of roots.
,, 25grm. of nitrogen in Mejillones....	71·0 ,, ,,
,, ,, ,, Leather-meal,	469·0 ,, ,,
,, ,, ,, Bone-meal....	1572·0 ,, ,,
,, ,, ,, Blood-meal .	1654·0 ,, ,,
,, ,, ,, Horn-meal....	2001·5 ,, ,,
,, ,, ,, Chili Saltpetre	2607·5 ,, ,,

These results have received corroboration from the results of some experiments subsequently made by Dr. Julius Albert with the above, and other manures. The composition of the oat is influenced to an important extent by different manures. For example, when fermented leather-meal and non-nitrogenous manures have been used, the proteids are from 8·7 to 10·7 per cent.; with Chili saltpetre and sulphate of ammonia, they amount to 11·2 and 11·1 per cent.; while, when bone- and blood-meal have been employed, the albuminoids amount to 13·6 and 11·6 per cent. Variations are also observed in the proportions of straw and mineral matter.—E. G. C.

Analyses of Volcanic Ashes and Lavas from Etna and Vesuvius. L. Ricciardi. Biedermann's Cent.-Blatt. 1884, 3, 208.

SPECIMENS of the above were analysed by the author with the following results:—

	Volcanic Ashes.		Lavas from Etna (Catania) (in the Year 1669).					
	Vesuvius. Feb. 25, 1882.	Etna. Jan. 23, 1882.	a.	b.	c.	d.	e.	f.
Silicic Acid	47·81	37·82	49·54	49·52	49·81	49·27	49·18	49·71
Titanic Acid	trace	trace	0·63	0·72	0·66	0·75	0·81	0·68
Sulphuric Acid	0·17	20·57	0·06	0·03	0·08	0·05	0·07	0·08
Phosphoric Acid	1·83	trace	1·19	1·27	1·28	1·21	1·26	1·17
Alumina	18·67	9·97	16·53	16·49	16·21	16·33	16·01	16·30
Ferric Oxide	4·38	—	10·71 (with Manganese Oxide)	9·45	7·76	4·79	7·67	9·92
Manganese Oxide	trace	trace						
Ferrous Oxide	5·07	14·05	2·41	3·63	4·52	7·78	5·47	2·95
Lime	9·12	11·98	12·30	12·33	12·39	12·53	12·71	12·37
Magnesia	3·77	3·61	4·70	4·77	4·03	4·52	4·71	4·63
Potash	2·01	0·95 (with Soda)	0·66	0·71	0·63	0·79	0·62	0·58
Soda	5·61		1·63	1·52	1·72	1·65	1·57	1·73
Loss on ignition	—	—	0·11	0·18	0·19	—	0·06	0·09
Chlorine	1·32	1·02	—	—	—	—	—	—
	—	—	100·47	100·62	99·31	99·67	100·11	100·21

a. Upper surface of lava-stream, weathered. *b* and *c.* Tuffs. *d.* Vitreous. *e.* Porous. *f.* Lowest layer.
—E. G. C.

Wool Dust. Dr. J. Nessler (Wochenbl. des Landw. Ver. in Bad. 13, 104). Biedermann's Cent.-Blatt. Agrik. Chem. 10, 705.

THE dust separated during the manufacture of woollen goods consists of fibres of wool intermingled with a fine powder. Dr. Nessler separated these two constituents with the aid of a sieve, determined their quantities, and also the amount of total nitrogen in each sample examined. The following figures were obtained with sixteen samples:—

No.	Fibre per cent.	Powder per cent.	Nitrogen per cent.	Value per Centner m.	No.	Fibre per cent.	Powder per cent.	Nitrogen per cent.	Value per Centner m.
1	—	—	9·68	3·87	9	50·0	50·0	6·53	2·61
2	—	—	5·90	2·36	10	11·0	89·0	3·17	1·27
3	40·0	60·0	5·23	2·19	11	43·0	57·0	5·37	2·15
4	11·3	88·7	2·30	0·90	12	17·0	83·0	2·98	1·19
5	17·4	82·6	3·20	1·28	13	—	—	1·08	0·43
6	17·0	83·0	3·75	1·10	14	29·0	71·0	5·41	2·17
7	7·0	93·0	2·16	0·96	15	11·0	89·0	2·18	1·19
8	23·0	77·0	3·36	1·31	16	—	—	3·45	1·38

No. 1 was extremely clean: Nos. 13 and 16 were greasy, and the amounts of fibre in them could not be correctly estimated. It is evident, from the figures, that the greater the proportion of fibre, the larger is the percentage of nitrogen, and therefore the greater the value of the sample.—E. G. C.

The Influence of Mineral Substances on Germination. P. P. Dehérain and E. Breal. Biedermann's Cent.-Blatt. 9, 618.

ACCORDING to the authors' experiments, among all mineral substances, lime exercises the most favourable influence upon germination. It is not a matter of indifference, however, under what form the lime is presented to the germinating plant; it is much more active when present as a salt of ulmic acid, than when combined with nitric acid. It seems that the ulmic acid acts directly in nourishing the young plant.—E. G. C.

On Sun-flower Seeds as Fodder for Cows. Dr. M. Schrodt and H. v. Peter. Biedermann's Cent.-Blatt. 9, 609.

SOME experiments made by the authors have shown that, as regards dietetic value, the use of sun-flower seeds is not disadvantageous; animals consume them with a good appetite, and do not alter in weight. Moreover, fodder containing an admixture of sun-flower seeds is a little cheaper than ordinary fodder.—E. G. C.

On the Employment of Chili Saltpetre and Sulphate of Ammonium in Beet-root Culture. O. P. Dehérain. Biedermann's Cent.-Blatt, 9, 593.

EXPERIMENTS made at Grignon furnished the following results, from which it appears that the ammonium salt has a prejudicial effect upon the development of the beet, if the soil does not contain sufficient organic constituents :—

1876 (Vilmorin).

	Yield kg.	Sugar kg.
Without Manure	17,100	14·5
100kg. Chili Saltpetre	19,000	12·7
400kg. Chili Saltpetre + 100kg. Superph.	21,400	13·1
1,200kg. Chili Saltpetre	21,100	12·6
100kg. Ammonium Sulphate	16,100	13·0
100kg. Ammonium Sulphate + 100kg. Superph.	16,400	13·0
1,200kg. Ammonium Sulphate	11,600	12·1

1877 (Vilmorin).

Without Manure	30,600	19·2
100kg. Chili Saltpetre	36,900	17·4
1,220kg. Chili Saltpetre	29,800	12·7
100kg. Ammonium Sulphate	29,950	17·0
1,200kg. Ammonium Sulphate	20,000	16·5

1877 (Vilmorin with rosy tint).

Without Manure	46,600	16·2
400kg. Chili Saltpetre	56,700	13·3
1,200kg. Chili Saltpetre	57,400	10·0
400kg. Ammonium Sulphate	41,600	15·3
1,200kg. Ammonium Sulphate	37,200	13·4

—E. G. C.

On the Formation of Milk. Hans Thierfelder. Biedermann's Cent.-Blatt, 1884, 3, 174.

THE author has made some experiments with the object of discovering the mode of formation and origin of milk-sugar and casein. For this purpose, the lactiferous glands taken from suckling rabbits and dogs, just killed and bled, were washed with brine, dried, and cut up with scissors into a fine pulp. About equal parts of this material were put into four weighed dishes, and the weights determined. Solution of common salt, and blood serum (from the same kind of animal) were then added, and two of the mixtures were now digested on the waterbath, the remaining two being put upon ice. Lastly, all four were treated with warm water, and heated with the addition of dilute acetic acid to coagulate and separate the albuminoids. In the filtrates the milk-sugar was determined volumetrically, the digested portions possessed a distinctly greater reducing power (from 7 to 20 per cent.) than the others. The author concludes, therefore, that milk-sugar is formed by the influence of a ferment upon a substance which he calls "saccharogen." The isolation of this substance has not yet been successfully accomplished, but the author declares it to be soluble in water, insoluble in alcohol and ether, and that it is not destroyed by boiling, and not identical with glycogen. The milk-sugar-producing ferment does not pass into an aqueous extract of the glands, but appears to be bound up within the cells. The experiments on the production of the casein were carried out in a similar way, and it appears that, during the digestion of the lactiferous glands at the temperature of the body, a body is formed, behaving like casein and apparently identical with that substance. Addition of serum-albumen from the same animal promotes the formation of this body, which is probably produced from the serum-albumen by the action of a ferment.—E. G. C.

On the Influence of Undecorticated Cotton-seed Cake as a Fodder upon Milk-production. M. Sievert. Biedermann's Cent.-Blatt, 1884, 3, 176.

DECORTICATED and undecorticated cotton-seed cakes differ not only in their composition, but also in their influence when used as fodder. They also have different origins. The undecorticated cakes are prepared chiefly from the entire seed of the Egyptian variety which is imported into England, and there milled. The decorticated cakes are prepared from an American variety, in which the wool is difficult to separate from the husk, and the kernels of which alone, therefore, are pressed into cakes. The experiments made by the author as to the comparative quantities and qualities of milk furnished by animals, fed, during successive periods of equal duration, with rape-seed cake and undecorticated cotton-seed cake, brought him to the conclusion that the influence of the latter upon milk-production is *not* a favourable one.—E. G. C.

On the Value of Wheat Bran as Human Food. Dr. Max Rubner (Zeitschr. für Biol. vol. xix. pp. 45-100). Biedermann's Cent.-Blatt. Agrik. Chem. 10, 677.

THE bran or husk of wheat, now usually separated from the meal, contains the most essential nutritive constituents in nearly the same proportions as the meal (the protein and fat are indeed somewhat higher); and it has, therefore, been remarked that the separation of the bran from the meal, and its employment as fodder, are causes of a serious loss of food to mankind. A society, called the Bread Reform League, has been recently formed in London, its objects being to teach the advantages of whole-meal bread over ordinary white bread, and to promote the general use of bread prepared from meal ground from the entire grain. Various experiments have been made by the author, with a view of finally ascertaining the answer to this important question, as to whether it is more rational to bake bread from the whole grain, or from the meal after the separation of the bran. Trials were first of all made with different kinds of bread, on man. The bread was made (1) from the finest sort of meal, constituting only 30 per cent. of the corn, which came from Odessa, California and England; (2) from a medium quality made from a mixture of Girka and Minnesota wheat, and representing 70 per cent. of the corn; and (3) from meal prepared from the entire grain—"the wheat-meal flour" of the Bread Reform League. The individual experimented upon (a full-grown man) consumed each day a loaf (about 900grm.) of bread, and 1500cc. of beer, the duration of the experiments being three days. The percentages of nutritive material lost with the excrement were found to be as follows :—

	Dry Substance.	Nitrogen.	Fat (Ethereal Extract).	Carbo-hydrates.	Ash.
Finest	4·03	20·07	44·69	1·10	19·28
Medium	6·66	24·56	62·83	2·57	30·35
Whole Meal	12·23	30·17	51·14	7·37	44·98

From these figures it is plain that the greater the amount of bran in the bread, the greater is the loss of nutritive material, which escapes unused in the excrement. The chief impediments in the way of a complete absorption of the non-nitrogenous and albuminoid substances in coarse-grained bread are, without question, the cellulose walls of the cells constituting the husk. As, notwithstanding that bran bread is less easily assimilated than ordinary bread, the former always contains a not inconsiderable quantity of absorbable nutritive matter, nothing—viewing the question exclusively from the standpoint of its value for the purpose of alimentation—can be urged against the use of bran for human food. It should, however, be ground much more finely than has hitherto been the custom. Viewed from the standpoint of public expediency, the practice of employing the bran in making bread is by no means to be recommended; for the gain in material, which will serve as human nutriment, is only obtained at the cost of depriving our domestic animals of food more easily digested by them than by mankind. The grinding of the whole grain, for human nourishment, must always, therefore, be attended with a certain loss. —E. G. C.

Experiments upon Quadrennial Rotation. Dr. A. Voelcker. Journ. Roy. Agric. Soc., Eng., 2nd ser., vol. xix. 224-233.

THE order, as regards manuring and sowing, in the four tracts chosen for the experiments, remained the same in

1882 as in the previous years. The four crops were wheat, barley, clover and turnips. *Rotation No.* 1.—Wheat. The year before this field had yielded white Dutch clover, on which sheep were fed. The seed was sown on October 23, but the ripening was somewhat hindered by rain and want of sunshine during the summer months. The harvest was on August 14; the results were as follows:—

No. of Parcel.	Manuring.	Heavy Wheat.		Small Wheat.		Straw, Etc.
		Kg.	1hl.=kg.	Kg.	1hl.=kg.	Kg.
1	Clover on the field eaten by sheep, which received as fodder 305kg. of cotton-cake	1125	76·6	53	68·9	2551
2	Clover consumed on the field; fodder 330kg. of maize....	1133	76·1	44	66·2	2512
3	Clover taken without fodder; in the earlier part of the year as much potash, phosphoric acid, nitrogen, etc., as were contained in 305kg. of cotton-cake	1050	75·3	93	68·1	2835
4	As 3; as much nourishment in the form of artificial manuring as was contained in 330kg. of maize	1208	75·0	31	63·8	2882

The quality of the wheat from parcels 1 and 2 was better than that from parcels 3 and 4, of which the latter had received a part of its nitrogen in the form of Chili saltpetre. Altogether, the amount of corn yielded in 1882 was considerably less than that obtained in the preceding year, but the quality of the grain was better, and the quantity of straw larger than in 1881. *Rotation No.* 2.—Barley. The turnips grown in 1881 were consumed by sheep, in the spring; the ground was ploughed in the beginning of April, and the barley sown on the 22nd of this month; in the middle of May white Dutch clover was sown among the barley. The latter was cut on September 11. The results obtained per acre were as follows:—

No. of Parcel.	Manuring.	Heavy Barley.		Small Barley.		Straw, Etc.
		Kg.	1hl.=kg.	Kg.	1hl.=kg.	Kg.
1	Without Artificial Manure (Cotton Cake Parcel)..	1114	61·9	76	56·4	1716
2	Without Artificial Manure (Maize Parcel)	1051	65·8	68	55·5	1705
3	56kg. Chili Saltpetre	998	65·0	91	55·1	1821
4	Without Artificial Manure	1019	65·4	60	55·1	1686

Here it is evident that parcel No. 1 gave the best result, while Nos. 2 and 4 were nearly equal as regards their produce. *Rotation No.* 3.—White Dutch Clover. The clover was eaten by sheep, of which those on parcel 1 were given cotton cake, and those on parcel 2 received maize. The animals consumed the following amounts:—

Parcel.					Kg.
1	10 Sheep during	88 days, and	5 Sheep during	22 days	155
2	10 ,,	88 ,,	6 ,,	22 ,,	181
3	10 ,,	55 ,,	6 ,,	23 ,,	89
4	10 ,,	60 ,,	6 ,,	22 ,,	52

Rotation No. 4.—Swedish Turnips (mangolds had previously been reared on this area). Seed sown on June 8th.; harvest in the second week in December.

No. of Parcel.	Manuring. Kg.	Turnips. Kg.	Leaves. Kg.
1	Stable Manure of 610 litter straw, 2268 beetroot, 567 chopped wheat straw, and 451 cotton cake	17,329	2,225
2	Stable Manure of 610 litter straw, 2268 beetroot, 567 chopped wheat straw, and 156 maize	17,079	2,203
3	Stable Manure of 610 litter straw, 2268 beetroot, 567 chopped wheat straw + 112 Chili saltpetre, 15 bone-ash superphosphate, 28 potassium sulphate, and 29 magnesium sulphate	19,671	2,455
4	Stable Manure like in parcel 3 + 36 Chili saltpetre, 7 bone-ash superphosphate, 3 potassium sulphate, and 5 magnesium sulphate	18,167	2,311

Here, as in the preceding year, parcel 3 (which had received the strongest mineral manure) furnished the highest result.—E. G. C.

Manuring Experiments. Dingl. Polyt. Jour. 252, 484.

Dehérain (*Compt. Rend.* 1884, 1286) has made a series of experiments extending over a period of four years, and found that one hectare of soil gave the following yields according to the character of the manure:—

	Feeding Maize. Kilos.	Potatoes. Hectolitres.
Sodium Nitrate	65,355	276·0
Sodium Nitrate and Superphosphate......	65,316	311·0
Ammonium Sulphate	60,035	290·5
Ammonium Sulphate and Superphosphate.	60,216	278·0
Without Manure	58,300	278·0
Superphosphate	58,100	276·0

—D. B.

Apparatus for Pressing and Preserving Green Crops for Ensilage. By D. B. Chatterton, Chester. Eng. Pat. 1944, January 23, 1884.

Upright girders of T or other suitable section, pass through the silo, and are bedded in a concrete floor. Longitudinal and transverse horizontal pressing girders are arranged to slide up and down the uprights as guides, and are covered with planks tongued with hoop iron, forming a watertight roof or cover to the silo. This cover is raised and lowered as required by means of screw jacks placed on the top of the cover, and secured by grips to the uprights at will. When the cover has been raised by the jacks to the height of the grip, the

cover itself is made to grip the uprights, and the jack grips are shifted higher up, the cover being thus raised by successive steps to the height required. Similar means are adopted for lowering the cover, and for exerting pressure on the ensilage.—J. M. H. M.

On Manure made from Peat Fibre. M. Fleischer. Biedermann's Cent.-Blatt. 1884, 3, 210.

Analyses of three samples in the raw state, and in the dried condition, yielded the following results:—

	Raw.	Dried.	Raw.	Dried.	Raw.	Dried.
Water	865·30	—	698·5	10·0	714·3	—
Fixed constituents	131·70	1000·0	301·5	—	285·7	1000·0
Mineral matter	21·40	158·8	?	—	47·7	—
Potash	3·10	23·3	2·8	9·3	2·3	7·9
Lime	1·10	10·6	?	—	1·5	5·1
Phosphoric acid	2·50	18·7	3·2	10·6	2·0	7·0
Nitrogen	6·28	16·6	8·1	27·8	4·9	17·3
Nitrogen in Free and Carbonated Ammonium	1·88	13·9	?	—	—	—

—E. G. C.

Improvements in Preparing Blood for Use as Manure. W. G. Strype, Wicklow Chemical Works, Ireland. Eng. Pat. 787*, January 5, 1884.

The original claim stood thus: Treating blood by means of a solution of sulphate of alumina or alum, *sulphate of iron or analogous materials* substantially as hereinbefore described. In the amended specification the words italicised are struck out.—J. M. H. M.

Manufacture of Artificial Manure. F. W. Martino, Arundel Street, Sheffield. Eng. Pat. 2354, January 29, 1884.

Basic cinder from the Gilchrist Thomas process is roasted with alum cake, sal enixum, or other material containing free sulphuric acid. A further portion of the basic cinder is roasted without any addition. Raw sewage is precipitated in a tank by the addition of the roasted mixture of cinder and alum cake in suitable proportion, the precipitate allowed to subside, and the clear liquor run off into a second tank. In this tank it is boiled, neutralised with basic cinder, the precipitate allowed to subside, and the liquid run off into a third tank, in which it is rendered distinctly alkaline by the addition of basic cinder and quicklime, again boiled, the precipitate allowed to subside, and the clear liquid run off, filtered through filter beds of raw basic cinder, and discharged into a river or stream. The three precipitates obtained as above are mixed in certain proportions, treated with sulphuric acid until slightly acid, powdered, and sold as manure. Instead of boiling the liquid a second time, as above described, the third precipitate may be obtained by the addition of a mixture of ground and calcined slag, caustic lime, bleaching powder, and animal charcoal.—J. M. H. M.

Improvements in making Butter, and Apparatus therefor. Haseltine, Lake, & Company, Southampton Buildings, London. Communicated by Th. Filter Company, Paris. Eng. Pat. 3163, February 12, 1884.

Instead of freeing the butter from buttermilk and water by washing and working, as generally practised, the butter, as soon as formed, is placed in a muslin or wire bag, which is rotated in a centrifugal machine at a high velocity for five or six minutes. The butter is then removed and kneaded just sufficiently to form it into a compact mass. A drawing of the centrifugal machine is given.—J. M. H. M.

Improvements in Preparing Lime for Agricultural Purposes. Isaac Brown, India Buildings, Edinburgh. Eng. Pat. 10,004, July 10, 1884.

Quicklime intended for agricultural use is ground to a fine powder instead of being slaked with water. It is intimately mixed with the soil by means of a distributor attached to the plough.—J. M. H. M.

Manufacture of Chemical Manures. By J. Mactear, Glasgow. Eng. Pat. 11,127, August 11, 1884.

The phosphatic, or other material, and the sulphuric acid being mixed together in a trough by rotating paddles in the usual manner, the mixture is delivered (instead of into a storing pit) on to a drying bed artificially heated, and is gradually moved forward over the surface of this bed by means of an endless chain armed with prongs. At the further end of the drying bed the manure is delivered into a trough furnished with a rotating screw blade, which carries the mixture to a "peg" mill, by which it is finally pulverised and delivered into sacks in a finished condition. A drawing is appended.—J. M. H. M.

Treatment of Phosphatic Substances for the Manufacture of Fertilisers. By O. Imray, 28, Southampton Buildings, Chancery Lane. Communicated by F. L. Harris, Baltimore, U.S.A. Eng. Pat. 11,191, August 12, 1884.

A solution containing nitrogenous organic matter is obtained by subjecting bone, hoof, horn, leather, hair, animal or fish offal, etc., to the action of water in a closed vessel at a temperature of 250-350° F. The insoluble residue of this operation is separated from the liquid, dried, ground, and sold as manure. The liquid, enriched with nitrogenous matter, is then used for the treatment of native phosphates, phosphatic guano, marl, marine shells, etc. The phosphatic material is placed in the liquid and subjected to a temperature of 250-350° F., as before. When sufficiently impregnated with nitrogenous matter, it is dried and pulverised. Drawings of a pressure boiler are supplied.—J. M. H. M.

Producing Economically Concentrated Assimilable Phosphates for Manure, and Soluble Phosphates for the Preparation of Phosphoric Acid and Phosphorus. By Michael Cahen, Brussels. Eng. Pat. 11,337, August 16, 1884.

The inventor proposes to substitute carbonic acid for sulphuric acid in the preparation of precipitated phosphate of lime for use as manure, and of soluble phosphate of lime for use in the manufacture of phosphorus. The carbonic acid to be employed is dissolved in water under considerable pressure (50 atmospheres), and this solution

is caused to act upon the phosphatic mineral until the whole of the phosphate of lime and carbonate of lime in the mineral shall have gone into solution, as monocalcic phosphate and calcium bicarbonate, leaving behind the insoluble gangue. The inventor states that on removing the pressure from a solution so obtained, carbonate of lime is precipitated, whilst monocalcic phosphate remains in solution, and the excess of carbonic acid employed is recovered. Further, that if the mixture thus obtained be heated to 100° C., the precipitated carbonate of lime is decomposed, more carbonic acid evolved, and precipitated tribasic phosphate of lime produced. The specification contains elaborate calculations, based upon the chemical equations supposed to be involved, and all the quantities are calculated upon the scale of equivalents in which O = 100. Drawings are appended.—J. M. H. M.

Improvement in Manufacturing "Cerealine," a Product obtained from Indian Corn. I. Franklin Gent, Columbus, Indiana, U.S. Eng. Pat. 12,186, September 9, 1884.

THE inventor claims the several steps of his improved process, which are—First, steaming the maize just enough to soften and toughen the hulls and germs; second, coarsely grinding or breaking the steamed corn, and separating the hulls and fine meal from the ground or broken material; third, picking the germs from the coarse, starchy particles; fourth, steaming the thus cleansed starchy particles; and, fifth, pressing and drying the steamed starchy particles to reduce them to thin flakes. A drawing and description of a mechanical picker or germ extractor are given. By this improved process, "cerealine" can be made and sold at prices which make it available for distilling as well as for brewing and edible purposes.—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, ETC.

The Circular Polarisation of Cane-Sugar. B. Tollens. Ber. 17, 1751-1757.

MEASUREMENTS by the author and by Schmitz (1876) showed that sugar and a number of other substances possess a greater rotary power when examined in dilute solution, than in strong. But as the strength of the solution is decreased, so does the experimental error make itself more and more felt, and as the apparatus then available was far inferior to that now obtainable, it appeared necessary to repeat these determinations with all possible accuracy. After describing the arrangements and apparatus used, a table is given showing the results obtained in examining eleven solutions containing from 1·1062 to 67·4507 per cent. of pure cane-sugar; 43 complete measurements were made, each the mean of twenty readings. The mean specific rotations (a) D of these solutions is 66·4°, and none of the determinations differ from this mean, by more than the error due to the observation.—H. B.

Circular Polarisation of Dextrose. B. Tollens. Berichte der Deutsch. Chem. Gesellsch. 17, 2234.

THESE experiments were undertaken with an improved apparatus of Landolt-Laurent, to prove whether the specific rotation of dextrose increases for (a) D, as some think, with solutions of a less concentration than 10 p.c. The dextrose was purified according to the method of Soxhlet, by crystallisation from water and alcohol, and dried directly before use from three to five hours, at 100° for series 1 to 7, and at 60° to 70° for series 8 and 9. The results obtained show that the specific rotary power increases with the concentration, and corresponds with the author's previous formula for dextrose-hydrate:

$$(a)\ D = 47{\cdot}92541^{\circ} + 0{\cdot}015334\ P + 0{\cdot}0003883\ P^2.$$

The old formula for anhydrous dextrose being:

$$(a)\ D = 52{\cdot}71795 + 0{\cdot}018796\ P + 0{\cdot}00051683\ P^2.$$

The following table gives the author's results:—

1. No. of Solution.	2. Percentage Composition.	3. (a) D Found Degrees.	4. (a) D Calculated: Old Formula Degrees.	5. (a) D Calculated: New Formula Degrees.	6. Difference between Col. 3 and 5.
4	1·4978	52·407	52·750	52·532	−0·125
8	1·7933	52·289	52·755	52·537	−0·248
2	2·0133	52·073	52·760	—	—
5	2·7533	52·370	52·771	52·556	−0·186
9	7·6012	52·691	52·891	52·673	+0·018
1	10·0272	52·133	52·958	—	—
7	10·0992	52·738	52·960	52·742	+0·004
3	10·2567	52·636	52·965	52·747	−0·111
6	17·5982	52·991	53·209	52·991	−0·000

It appears, therefore, that the amount found, and that calculated from the author's formula, agree very closely; the former, however, being somewhat too low. The following formula is therefore given as being a close approximation to the truth. For anhydrous dextrose:

$$(a)\ D = 52{\cdot}50^{\circ} + 0{\cdot}018796\ P + 0{\cdot}00051683\ P^2.$$

For dextrose hydrate:

$$(a)\ D = 47{\cdot}73 + 0{\cdot}015534\ P + 0{\cdot}0003883\ P^2.$$

These formulæ are correct for all concentrations from 1 to 100 p.c., and an increase of rotary power for 1·2 p.c. solutions does not exist.—J. B. C.

An Improvement in the Strontia Treatment of Saccharine Liquors and Apparatus for that Purpose. John Imray, London. Eng. Pat. 1999, January 23, 1884.

WHEN anhydrous strontia is applied directly to saccharine liquors, the heat developed is so great that the operation is virtually impracticable. To overcome this difficulty anhydrous strontia is first mixed with moist hydrate of strontia; great heat is evolved, by which much of the water is driven off, and there results a monohydrate or low hydrate of strontia, which is well adapted to the treatment of saccharine liquors. The apparatus in which this treatment is effected consists of a strong closed vessel, having, a little way from the bottom, a finely perforated screen, and having supported near the middle of its height a grating. The lower part of the vessel is charged with the saccharine liquor, and the strontia, prepared as above, is placed on the grating. By means of steam the liquor is heated and agitated, until it gradually combines with the strontia, forming a sucrate. The sucrate is more insoluble if a steam pressure of one or two atmospheres be used. When the reaction is complete the steam is turned off and valves are opened to reduce the pressure, and to equalise the pressure in the top and bottom portions of the vessel. The precipitated sucrate settles on the screen at the bottom, and the liquid is drawn off; the precipitate is now washed with water, preferably containing strontia to prevent the solution of any sucrate. By concentration and cooling of the mother and wash liquors, the excess of strontia is recovered in the form of crystallised hydrate.—A. J. K.

An Improved Method of, and Apparatus for, Treating Sugar-cane Preparatory to the Extraction of Sugar therefrom. W. R. Lake, London. Communicated from E. Schulze, Amsterdam. Eng. Pat. 13,940, October 21, 1884.

By a specially constructed cross-cutting machine the sugar-canes are first cut into short lengths, about four to five inches long; these pieces are next cut into thin slices by a machine essentially the same as those which are used for preparing beet-roots for the diffusion process. The sugar can now be extracted from the canes by the diffusion process in a manner exactly similar to that which is well known in the case of beet-roots.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

On the Methods of Cleaning Beer Pumps. By Kohlmann. Chem. Zeit. viii. 60, 1078.

Different views are held with regard to the agents to be used in the cleansing of beer pumps, and opinion seems principally divided between steam and alkaline solutions. Experiments conducted by the author show that the steam process does not always sufficiently do the work required, while very good results were obtained with a cold 2% solution of caustic soda. This latter method is also cheaper than that of steam.—F. T. S.

Making and Preserving an Extract of Hops or other Aromatic Products, without losing the Flavour. J. Armstrong, London. Eng. Pat. 71, January 1, 1884.

The preparation of the extract is to prevent the escape of the aromatic principle of the hop. The hops are infused with water or any other suitable liquid in a closed and jacketed vessel at a temperature of 160° F., which is gradually raised to 200° F. or thereabouts, infusion being continued for about forty minutes. A second and similar infusion is then made, the two products being mixed together. To the infusion there is then added syrup of invert sugar, glucose, or wort, all of which possess the well-known property of preserving the aromatic properties of the hop. The patentee claims generally the preparation of the extract as above described.—C. C. H.

An Improved Portable Distilling Apparatus. W. Hood, Seacombe, Cheshire. Eng. Pat. 2445, January 31, 1884.

This specification describes a portable form of distilling apparatus suitable for the use of wine merchants. It consists of a small boiling vessel, over and attached to which is a vessel containing the condensing worm, and attached to the upper part of this again is a reservoir for the cold condensing water. The boiler is heated by a self-contained gas burner of the usual construction. The patentee claims the combination of the different parts of the whole apparatus and its construction.—C. C. H.

An Improvement in the Production of Malt. H. J. Haddan, London. Communicated by H. Hackman, Bavaria. Eng. Pat. 2468, January 31, 1884.

In the germination of grain for the production of malt in the usual way, the exterior grains in the heaps of barley become dry, and do not therefore properly germinate. In order to avoid this the patentee sprinkles the exterior of the heaps with a spray produced by means of compressed air, which furnishes their exteriors with enough moisture to prevent contact with the air, and not too great in quantity to injuriously affect proper germination. The claim is made as and for the purpose described. —C. C. H.

Improved Applications of the Residue Produced by Distilling Wine. J. C. Mewburn, London. Communicated by H. Crot, Paris. Eng. Pat. 2678, February 4, 1884.

The residues from the distillation of wine in the production of brandy usually called "vinasse" possess no value, because their flavour has been totally changed by the operation of distillation. In order to obviate this, this patent proposes that the distillation of the alcohol should be conducted in vacuo at a temperature not exceeding 15° C. After the elimination of the alcohol the vinasses can be evaporated to a syrup which, retaining the properties of the original, can be employed for mixing with low wines to give them body and flavour. It may also be made into a beverage by adding a solution of sugar and bottling. The patentee claims—(1) the utilisation of the residues by distilling at a low temperature as described; (2) the manufacture and production of non-alcoholic beverages as described.—C. C. H.

An Improved Manufacture of Non-alcoholic Beverages from Grapes or other Fruit. A. C. L. Weigel, Brighton. Eng. Pat. 8132, May 23, 1884.

The object of this invention is the production of a beverage possessing all the properties of wine prepared from the grape, but at the same time being non alcoholic. After fermentation in the usual way the must is distilled in vacuo at a temperature not exceeding 160° F., the ether being collected separately from the alcohol. The residue from distillation is cooled in a closed vessel out of contact with the air and refrigerated by ice, the ethers are added and also a certain proportion of syrup made by evaporating unfermented grape juice; this may then be filled into bottles for consumption. If a sparkling beverage is required the same liquid may be bottled saturated with carbonic acid gas in the same way as aerated waters. The claim is for the manufacture of non-alcoholic fermented beverages substantially as described. C. C. H.

Liquid Hop Auxiliary. F. W. E. Shrivel, London. Eng. Pat. 10,427, July 22, 1884.

The liquid hop auxiliary consists of an extract prepared from quassia, chiretta, columbia root, gentian root, camomile flowers, cinchona bark, or any other vegetable bitter, and mixing it with tannic acid, or any substance capable of precipitating albumen, and a certain proportion of hops. The extract may be prepared by any of the usual well-known means, and the object is to produce a liquid which can replace hops in brewing, or for any such analogous use. The claims are: (1) The hop auxiliary or liquid as described; (2) the preparation of the same in a liquid and not in a solid form.—C. C. H.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

Purification of Water. Wm. Anderson, Westminster. Eng. Pat. 5496, November 23, 1883.

This invention relates to the purification of water by means of spongy iron. Its objects are:—To preserve the purifying agent in an active condition by keeping its surfaces clean and free from the slimy matter removed from the water, and also to avoid the use of the very large quantities of the material necessary in percolation methods and the expense consequent thereon. To effect these objects, the spongy iron is kept continually in a state of motion, and made to fall through a stream of the water passing through the purifying apparatus. The apparatus consists of a cylinder suspended on hollow trunnions, which serve as inlet and outlet respectively for the water operated upon. The cylinder is capable of being rotated, and its interior periphery is provided along its whole length with projecting shelves or ledges, so that the spongy iron introduced into its interior is, during rotation, carried upwards, and falling from the shelves passes through the current of water running through the cylinder, thus effecting by its intimate contact the required purification. The process is therefore continuous. The respective ends of the cylinder opposite the trunnions, serving for inlet and outlet, are provided with a deflecting plate to avoid the disturbance of the spongy iron, and a strainer plate, so that it cannot be carried away by the force of the current. The purified water is finally exposed

to the air to oxidise the iron entering into solution, and filtered through a sand filter. The novelties claimed are (1) the process of purification of water by its passage through a revolving cylinder containing spongy iron: (2) the apparatus substantially as described.—C. C. H.

Treatment of Sewage. F. Herbert, London. Eng. Pat. 5850, December 24, 1883.

In order to effect the deodorisation of sewage of all kinds, and in its entirety obtaining therefrom valuable manures, and for the utilisation of the gaseous bodies given off during treatment, the patentee proceeds as follows:—The sewage is collected in tanks in which, by subsidence, it is deprived of such useless mineral matter as road detritus, &c.; self-acting syphons fitted to these tanks periodically transfer their contents into a series of receivers fitted with carbon electrodes, connected with a dynamo electric machine furnishing a current of large quantity, but low intensity. The gases liberated by electrolysis are collected and burned for furnishing steam power, and after being carburetted used for lighting. The thin mud obtained by electrolysis is evaporated down by a gentle heat in a suitable drying apparatus, yielding a highly valuable manure. The patentee claims (1) the use of electricity for the purpose of treating sewage; (2) utilising the gaseous constituents; (3) the combination and arrangement of the apparatus.—C. C. H.

Improvements connected with Filters for Water and other Liquids. F. Grosvenor, Glasgow. Eng. Pat. 1415, January 14, 1884.

A filtering vessel is formed of an outer carbon crust, made by cementing coke or carbon with tar or rosin, and baking the same for some hours, the hollow interior being filled with loose finely-ground animal charcoal. The end is provided with an earthenware cup for fixing the carbon chamber in a filtering vessel. The specification claims the composite carbon filtering block as described.—C. C. H.

Apparatus for Withdrawing and Filtering Water or other Liquid contained in a Vessel or Receptacle. P. Garton and J. Garton, Golborne, Lancashire. Eng. Pat. 1591, January 17, 1884.

In order to withdraw and filter a liquid from a vessel at the same time, the following apparatus is described. A syphon tube is furnished in its longer limb with a cock, and provided at the end of the shorter limb with a filtering vessel, which is funnel-shaped, and divided into two parts by a perforated diaphragm. The upper portion contains animal charcoal, or any other filtering media, and the lower part is filled with sponge, secured in place by a screwed plate. The filtering chamber is placed in the liquid to be operated upon, and the syphoning established by lowering the free end of the tube and exhausting the air. The patentees claim the combination of a syphon tube with a filtering chamber for the purpose described.—C. C. H.

Improvements in Filters. W. N. Wilkinson, Manchester. Eng. Pat. 1791, January 21, 1884.

The improvements herein specified refer to those filters used for purifying water for a domestic supply, and also more particularly to pocket filters. The object is to so arrange the filtering material that it shall be under compression during filtration. The general form of the improved apparatus is as follows:—A top and bottom plate, the latter being fitted with a tube passing through the upper plate. The tube is fitted with a compression spring and loose washer; between the two plates there is secured a helical roll of perforated metal covered with cloth, the interior filled with animal charcoal or other suitable filtering material. A thumb screw at the top, acting upon the spring, presses upon the charcoal and at the same time compression is also exerted upon it by the perforated outer covering. The exterior, in some instances, is covered with India-rubber, which serves to regulate the supply of water to the interior of the filter and also keep it clean on the exterior. Different modifications of the apparatus are also described. The patentee claims under four heads the various details specified.—C. C. H.

Producing Mixtures of Liquid Acids and Dry Powders for Use with Disinfectants, and as Absorbent Materials for Ammonia. D. Urquhart, Westminster. Eng. Pat. 221, January, 1884.

Sulphuric or other fluid acid is mixed with infusorial, or other absorbent inert earth, in proportions to preserve the condition of a powder. This acid powder is mixed with chloride of lime, dry sulphites, or potassium chlorate, for use as disinfectants. The acid powder is also used for cleaning brass, etc., or for absorbing ammonia from furnace gases. The acid powder is said to be sufficiently devoid of corrosive properties to be packed in iron or wooden cases.—G. H. B.

Improvements in Appliances for Filtering Water and other Liquids. J. P. Jackson, Liverpool. Eng. Pat. 7247, May 5, 1884.

The apparatus described consists of an exterior vessel of a cylindrical or other shape, acting both as a receiver for the filtered material, and also as a holder for the remaining parts of the apparatus. The interior of the receiver is fitted with a similarly shaped vessel, conical at its lower extremity, which is perforated along a portion only of the conical surface either with fine holes or oblong slots, and is provided at its conical extremity with an asbestos cloth cover fitted thereto. A second long conical vessel projects downward into the filtering vessel as above described, provided at its lower extremity with a projecting rim to check the rush of the liquid poured into the filter. The first portions of the liquid poured in may be mixed with paper pulp, animal or vegetable charcoal, &c., for the purpose of securing both a fine filtering surface on the asbestos cloth as well as a purifying effect; or the lower part of the conical filter may be packed with animal charcoal. The claims are: (1) the funnel provided at its lower extremity with the projecting rim; (2) the chamber partly conical, with perforated and solid walls carrying the asbestos cloth; (3) a pocket filter of similar construction to the above.—C. C. H.

Improvements in the Production of Vegetable Carbon for Hygienic, Electrical, and similar purposes. A. F. Westerlund, Stockholm, Sweden. Eng. Pat. 11,322, May 21, 1884.

For the production of a slow-burning carbon, suitable for insulating, preserving, disinfecting, and hygienic purposes, the inventor uses straw, hay, paper, cork waste, cotton sphagnum, and other vegetable materials, which he treats with a solution of boric acid or a soluble borate before carbonisation. Owing to this preliminary treatment, the carbonisation may be effected by free access of air. In a patent application bearing even date with this specification, a similar mode of producing a slow-burning carbon is described, only that the solutions used are made with phosphoric acid or phosphates. The inventor, however, wishes it to be clearly understood that a slow-burning carbon having the same properties as that obtained by the above-described method may be produced by the use of mixed solutions of phosphoric and boric acids or phosphates and borates.—D. B.

XIX.—PAPER, PASTEBOARD, Etc.

Effect of Mineral Matter on the Properties of Paper. Prof. Hartig. Dingler (252), Heft 6.

The paper used was a resin-sized straw paper, without added mineral matter, with 2·05 per cent. of ash: one square metre weighing 259grm. The same paper when

hotpressed weighed 264grm. per square metre. The same, with an addition of 15 per cent. gypsum, has 17·2 per cent. ash, and weighed 239grm. per square metre. The paper by hotpressing increased—

In absolute rigidity	9·4 per cent.
In tenacity	6·6 „
In the modulus of the work of tearing	16·5 „

On the other hand, it lost by the addition of 15 per cent. of gypsum—

In absolute rigidity	31·2 per cent.
In tenacity	23·1 „
In specific work of tearing	47·1 „

Through the addition of 15 per cent. of gypsum, the resistance to tearing is reduced to about a half.—F. L. T.

Manufacture of Pulp, etc. George Boulding Walker. Eng. Pat. 5306.

THE inventor separates the fibre from different species of Yucca by means of specially constructed teazing machines, descriptions and drawings of which are given. The isolated fibre is then treated with chlorine solution or chlorine gas. It may afterwards be boiled in dilute alkali, and further treated with weak chlorine solution.
—C. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES.

Alkaloids of Nux Vomica. Some Experiments with Strychnine. By W. A. Shenstone, Lecturer on Chemistry in Clifton College. Abstr. Proc. Chem. Soc. 1884-5 [1.]

IN continuation of his experiments on strychnine, the author has studied the action of bromine upon the alkaloid, and also the action of nitric acid on bromostrychnine and upon strychnine itself. Strychnine can be readily and entirely converted into the monobromostrychnine of Laurent by the addition of bromine to a solution of strychnine hydrochloride in about fifty times its weight of water. The properties of monobromostrychnine are given. The resinous product obtained by Laurent, which is apt to be the chief product obtained by his method, is found to be a dibromide of the above monobromostrychnine; it has the formula

$$C_{21}H_{21}BrN_2O_2Br_2.$$

By the cautious addition of a solution of bromine in chloroform to a solution of monobromostrychnine in the same liquid, a resinous compound is obtained, which is probably dibromostrychnine. On treating bromostrychnine and also strychnine itself with strong nitric acid, besides the nitrostrychnines of various observers, a fair amount of 1 : 2 : 4 : 6 trinitrophenol is produced. This last observation is of importance, as it shows the presence in strychnine of a benzene-ring of carbon-atoms, and probably also of at least one hydroxyl-group, the latter inference being confirmed by the behaviour of strychnine with alkaline oxidising agents.—W. S.

On the Physiological Action of Brucine and of Bromostrychnine. By Dr. T. Lauder Brunton, F.R.S. Abstr. Proc. Chem. Soc. 1884-5 [1.]

THE difference between the effect of brucine and strychnine appears rather to be one of degree than of kind, and to be chiefly dependent on the more ready elimination of brucine. Like strychnine, brucine produces death by convulsions and not by paralysis; but like curare, it is innocuous when taken into the stomach, though fatal when injected under the skin. Bromostrychnine has an action very much like that of strychnine.—W. S.

On the Formation of Pyridine Derivatives. By H. v. Pechman and W. Welsh. Abstr. Proc. Chem. Soc. 1884-5 [1.]

IT is pointed out that nothing is as yet known of the character of the changes which occur in plants and which lead to the production of the alkaloids, and that it has not hitherto been possible to produce alkaloids by reactions taking place under ordinary conditions of temperature. In coumalinic acid, discovered by one of the authors, and obtained by treatment of malic acid with sulphuric acid (*Ber.* 1884, 936), however, a body has been discovered which at once reacts with aqueous ammonia even at the ordinary temperature, forming hydroxynicotinic acid,

$$C_5H_3O_2.COOH + NH_3 - OH_2 + C_5H_3N(OH).COOH,$$

an acid which stands in close relation to the alkaloids. The method of preparing hydroxynicotinic acid and its properties are described, its constitution is fully discussed, and an account is given of its conversion into chloronicotinic and nicotinic acids. Reference is then made to the action of primary amines on ethereal salts of coumalinic acid. Aniline and the methyl salt give the acid methyl salt of *coumalanilidic acid*,

$$COOH.C_4H_3(NH.Ph).COOMe,$$

which is converted by boiling with sodium hydroxide solution into sodium phenoxynicotinate,

$$C_5H_3N(OPh).CO_2Na,$$

a remarkable change, as it involves the "passage of phenyl from nitrogen to oxygen." The same remarkable isomeric change takes place when the product of the action of methylamine on methyl coumalinate is similarly treated, methoxynicotinic acid being formed.
—W. S.

The Santonine Industry of Turkestan. By C. O. Cech, Moskau. Dingl. Polyt. Journ. 253 (11), 474.

IN the town of Tschemkent, in Turkestan, a large works is being at present erected for the manufacture of santonine from worm-seed. The seed of the plant (*Artemisia Santonica and Maritima*), which in large quantity is exclusively found in the valley of the Arissi, contains from 1·8 to 2·3% santonine. More than 1600 tons of the plant are annually consumed, partly in the raw state and partly after conversion into santonine, of which 1kg. is worth from £2 to £3. The manufacture was carried on up to the present by three works in Germany and one in England, which obtained their raw material at a considerable expense for carriage from Turkestan. Since 100kg. of worm-seed yield about 2kg. of santonine, the new works, situated at the place where the raw product is found, will work under the most favourable conditions, and their make will evidently come into the market at a price to exclude the competition of European makers. As a matter of fact, two German works have already resolved upon discontinuing the manufacture of that commodity. The new works will cost £65,000, and are large enough to work up 1600 tons worm-seed—*i.e.*, to make 32,000kg. santonine. The residues of the manufacture, formed into bricks, will be used as fuel for boilers and houses. The works are nearly finished, and it is intended to commence manufacturing in October, 1884.—S. H.

Manufacture of Salicylic Acid. Theodor Kempf, Berlin. Eng. Pat. 5582, November 30, 1883. Provisional protection only granted.

IF diphenyl-carbonate be heated with phenol sodium in a closed vessel, provided with an agitator, for about six hours at a temperature of 160° to 170° C., basic sodium salicylate is formed, and free phenol and diphenyl-ether are liberated. The basic salicylate can then be treated in the ordinary manner, for the liberation of the acid, by treating its aqueous solution with hydrochloric acid.
—C. C. H.

Manufacture of Salicylic Acid, etc. J. H. Johnson, London. Communicated by Otto Leupold, Stuttgart. Eng. Pat. 5628, December 4, 1883.

THIS invention deals with the manufacture of salicylic acid, which it effects by causing alcoholic carbonic ethers to react by decomposition upon combinations of sodium

and phenols, either with or without mixture with sodium hydrate or sodium alcoholate. If one equivalent of ethyl carbonate be heated with two equivalents of phenol sodium in a closed vessel, at a temperature of 120° to 150° C., basic sodium salicylate is produced and alcohol and phenetol distilled off; similarly, ether, carbonic ethyl phenol sodium and sodium hydrate give alcohol and basic salicylate of soda, and in the case of alcoholate of soda ethylic ether is also produced. The basic salicylate of sodium is decomposed by precipitating the salicylic acid by means of a mineral acid. The patentee claims as novel, the production of salicylic acid by heating carbonic ethers with phenol, sodium compounds thereof, hydrate of soda or alcoholate of soda.
—C. C. H.

Quinine Alkaloids. P. Giacoso. Eng. Pat. 1472, January 15, 1884.

THE inventor has discovered that the alkaloids of Peruvian bark occur in plants of the genus *Artemisia*, from which they can be extracted either in the ordinary manner or according to the following method:—The fresh or dried flowers and seeds, together with the whole plants (the best is *Artemisia Abrotanum Linn*), must be chopped fine and digested in diluted acid (sulphuric hydrochloric acid, etc.). The extracts obtained by the diluted acid are neutralised, and precipitated by a base. From the filtered moist basic mixture, the alkaloids are obtained by heat with schist oil, coal oil or petroleum having a low boiling point, or by means of alcohol. In the latter case the alcohol must be distilled off, the residue must be treated with diluted acid, and the alkaloid precipitated by means of carbonate of soda or another base. From the solution in the hydrocarbons the alkaloids can be transformed into salts by means of acids, and separated afterwards by means of carbonate of soda, or another base.—F. L. T.

Apparatus for preparing Oxygenated Air. By G. F. Redfern. Communicated by Anton Stamm, Leadville, Colorado. Eng. Pat. 8285, May 27, 1884.

THE inventor makes use of two air-tight water tanks, and two nitrogen tanks, in conjunction with an air compressor of any description. By means of an arrangement of slide valves, actuated by any suitable motive power, the air compressor forces air alternately into each of the two water tanks, and at the same time removes the air impoverished in oxygen by its passage through the water into the two nitrogen tanks, also alternately. At every stroke, therefore, air rich in oxygen is being delivered from one or other of the water tanks, and air poor in oxygen is being stored in one or other of the two nitrogen receivers. To increase the percentage of oxygen, the air as delivered from the water tank is passed through a second similar, but smaller, apparatus. The claims are for such an arrangement of slides, or other valves, in conjunction with the tanks as will render the operation automatic.—J. M. H. M.

XXI.—EXPLOSIVES, MATCHES, Etc.

Novelties in the Manufacture of Explosives, Blasting Materials, etc. Dingl. Polyt. Jour. 254, 110.

A BLASTING material called hellhoffite was shown at the Berlin Hygienic Exhibition, of 1883; this compound is prepared by Hellhoff, of Mayence, and consists of dinitrobenzol and nitric acid. The constituents are mixed in the apparatus shown in Fig. 1. A cartridge is represented in Fig. 2, and the funnel used for filling the cartridges is seen in Fig. 3. C. H. Wolff recommends a process for the estimation of nitrogen in nitro-compounds, which is easily carried out, and is an amplification of the Champion-Pellet and Hefs method. In a small decomposition flask *z* (Fig. 4), 0·10 to 0·14grm. of nitroglycerine or blasting gelatine, or 0·15 to 0·18grm. of dynamite, is placed, together with 50c.c. of a previously boiled and again cooled concentrated solution of chloride of iron and hydrochloric acid. Carbonic acid gas is now conducted through the closed flask, from the apparatus *a*, until the bubbles of gas issuing from the tube *g* are completely absorbed by the 20 per cent. caustic soda solution contained in the graduated tube. When complete absorption takes place the cock of the carbonic acid apparatus is closed, and the flask is heated very gradually. Decomposition now

FIG. 1.

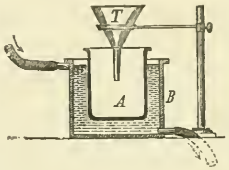
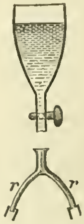


FIG. 2.

FIG. 3.



ensues, with the evolution of nitric oxide. After the reaction is over, the contents of the flask are boiled down to a few cubic centimetres, and the last traces of nitric oxide are conducted into the measuring-tube by the aid of a stream of carbonic acid gas. For the

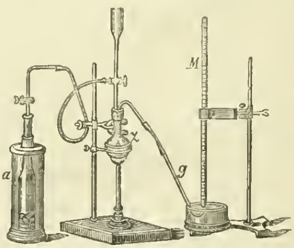


FIG. 4.

removal of nitroglycerin from dynamite, etc., W. Hampe uses Szombathy's apparatus for the estimation of fat in milk. This consists (Fig. 5) of an extraction tube A, with a connecting tube *b*, and an over-flow tube *c*; the top of this extraction tube is connected with a vertical

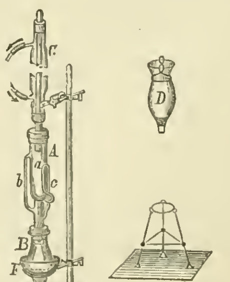


FIG. 5.

condenser C, and its lower end passes through the cork of a small flask B, containing about 25c.c. of ether. The contents of the flask can be warmed in the water-bath F to from 70 to 75°. The dynamite is weighed in the

blown head of a thistle funnel D (fig. 6), containing a plug of glass-wool or asbestos; the funnel head is fastened to a ring of platinum wire, and it can be placed in a small stand made of platinum wire (fig. 7). Ten to 12grms. of dynamite are weighed off, dried over sulphuric acid, placed in the extraction tube (in which the top of the funnel head will be at the level *a*), and treated with ether, until the solvent begins to run down by the syphon *c*. When the flask B is warmed, ether-vapour passes up through *b* into the condenser C, is condensed, drops upon the dynamite and gradually fills the tube A again, until the mark *a* is reached, when it runs back by the syphon *c* into the flask B. This circulation of the ether will take place 12 times in one hour; and within five hours 10grms. of blasting gelatine can be completely extracted, while 10grms. of gelatine dynamite can be entirely extracted in three hours. W. Rennert has introduced a modification of the warm process for the production of blasting materials, according to which he treats an intimate mixture of the materials by the direct action of steam: 75 parts of saltpetre, 13 parts of charcoal from white wood, 9 parts of sulphur, and 3 parts of flour or starch are made into a paste with 6 to 8 litres of water, brought into a steam apparatus, and there mixed with steam at a pressure of 2·5 to 3 atmospheres. The mixture is then run out, cooled, pressed into cartridges, and lastly dried. John Waffen, of Knittelfeld, has invented a powder, to which he has given the name of lederite. This compound consists of 45 parts of nitre, 15 parts of sulphur, 20 parts of red lead, 18 parts of leather cuttings (!), and 2 parts of picric acid. The poisonous vapours which would be evolved by this blasting powder constitute a formidable disadvantage, inseparable from its use. R. Punshon and R. R. Vizer, London, have patented a new process of blasting, in which they employ two glass cylinders, one filled with nitric acid and the other with picric acid, enclosed together in a case, so that, when the latter is placed in the bore-hole, the two compounds can by simple means be caused to mix and produce the required explosive. The principle of this invention is not new, the novelty consisting in its application to blasting purposes. Some experiments made at Saarbrücken with pressed powder (already widely used in England) tend to show that it is less dangerous to handle, less liable to miss discharge in wet coal, and that it is more effective than granulated powder, than which it is, according to recent experiments, 35 to 45 per cent. more powerful.—E. G. C.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Analysis of Vegetable Substances. E. Reichert. Arch. Pharm. 222, 415.

THE author recommends the following method of procedure:—(1) determination of the ash; (2) determination of the protein substances—viz., by determination of the amount of nitrogen by Will-Varrentrapp's method and multiplication of the result by 6·25; (3) examination of the substance dried at 100°. 1 or 2 grm. are extracted with ether, and the dissolved portion reckoned as fat; the insoluble residue is extracted with 10 to 20 times its quantity of alcohol, and the soluble portion estimated as sugar; the insoluble residue is then treated with water, and the gum extracted and determined. The residue insoluble in ether, alcohol, and water, is boiled with 20 to 30cc. of 5 per cent. sulphuric acid for an hour or more, while connected with a reversed condenser, filtered, and the residue boiled with 5 per cent. solution of caustic soda; the undissolved cellulose is washed, dried at 100° and weighed. The united acid and alkaline filtrates are united, strongly acidified, and boiled one or two hours and tested with Fehling's solution. The residues from the alcoholic and ethereal solutions require further examination.—H. B.

The Determination of Manganese and Phosphorus in Iron, Steel, etc. M. Troilius. Berg-u-Hüttenm. Zeit., 1884, 284.

THE fullest details are given for the separation of the manganese as dioxide, by boiling the strong nitric acid solution with potassium chlorate. The chlorate must be added gradually and the solution repeatedly boiled, in order to get a complete separation. Phosphorus is determined by the ammonium molybdate method, which is also most fully detailed.—H. B.

An Indicator for Use in Alkalimetry and Acidimetry. A. Gawalowski. Biedermann's Cent-Blatt. Agrik. Chem. 1884, 4, 286.

THE author employs a mixture of alcoholic solutions of phenolphthalein and dimethylaniline orange or methyl-orange. The mixture is lemon-yellow when quite neutral, and, on the addition of a drop of acid or alkali, is within from four to five seconds coloured rose-red or deep red, respectively.—E. G. C.

On the Estimation of Silicon in Iron and Steel. Thos. Turner. Chem. Soc. Journ. July, 1884.

IN the course of an investigation on the influence of silicon in iron and steel, the author had occasion to examine the various methods proposed for its estimation, and also for its separation from the slag present in the metal.

Estimation of Total Silicon.—I. The ordinary method of treating the finely divided metal with strong hydrochloric acid, evaporating to dryness, extracting with hydrochloric acid, washing, drying, and igniting the residue, gives rapid and tolerably accurate results with metal containing not more than 2·5% of silicon. The presence of manganese has no effect upon the results. This method has also the disadvantage of yielding a very bulky residue, from which it is difficult to burn the graphite. II. A method recommended in some text-books, of treatment with hot strong hydrochloric acid, and filtering without previous evaporation, is not to be relied upon. III. Fusion of the silicious residue obtained by evaporating the hydrochloric acid solution and further separation with hydrochloric acid, gives perfectly reliable results, but the method is somewhat troublesome. IV. A fairly accurate method with moderate amounts of silicon, though giving somewhat high results with larger amounts, consists in treating the finely divided metal with hot aqua regia, evaporating to dryness, washing, filtering, drying and igniting. It has the advantage of yielding a residue from which the graphite is easily burned away. V. Drown's process (*Chem. News*, 42,331) consists in treating the metal (not necessarily finely divided) with nitric acid, sp. gr. 1·2, and when the action has ceased, adding a small quantity of strong sulphuric acid. The solution is evaporated until it solidifies, when water is added and the liquid heated and filtered. The silica thus obtained is snow-white and granular. The method, which is neat and rapid, is not however applicable with large percentages of silicon and manganese.

Separation of Slag.—For this purpose the author recommends a modified form of the chlorine process. "The iron or steel, in large or small fragments, is placed in a porcelain boat and is burned in a stream of dry chlorine free from air. The excess of gas passing through the combustion tube is washed by passing through water contained in a weighed Varrentrapp's bulb. When the combustion is completed, as indicated by the entire absence of red vapours near the boat, the current is maintained for five to ten minutes, and the solution afterwards evaporated to dryness. The residue is extracted with hydrochloric acid to remove any iron, etc., sometimes carried over, then filtered, washed and ignited. The bulb is also weighed, after being carefully dried at 100°. These two weighings together furnish the whole of the unoxidised silicon originally present in the iron. The residue left behind in the boat contains carbon and slag, and also part of the manganese, a little iron as chloride, etc. It may be most conveniently transferred to a test-tube, boiled with a little dilute hydrochloric acid, filtered, dried and ignited. It is necessary to estimate the silica present in the residue, by fusion in the ordinary way, before any trustworthy opinion can be formed as to the amount of slag present. When this is done, the results

obtained by adding together the total silica found agree with those got by any other trustworthy method." In conclusion, the author sums up as follows:—"1. That methods I., III., IV. and V. give fairly concordant results with steel and ordinary cast-iron, while of these four the method proposed by Drown has the advantages of most rapid action, least bulky residue, and most easily burned graphite. 2. That for silicon pig and silicon ferro-manganese, methods I., II. and V. are quite inapplicable, while III. and IV. give moderately accurate results; but all these methods are incapable of distinguishing between oxidised and unoxidised silicon. 3. That the chlorine process in the modified form above suggested, has the great advantage of distinguishing between the unoxidised silicon and slag, whilst it is rapid and fairly accurate with all classes of iron, and hence may help to supply a long-felt want of the iron and steel analyst."—E. J. B.

The Analysis of Zinc Flue-Ash and Pyrites Residues by the Carbonate of Ammonia Process. By B. Kosmann. Chem. Zeit. viii. 61, 1091.

UNDER the common head of Zinc Flue-Ash come (1) the grey "Poussiere" from the zinc distillation; (2) the flue dust from the chambers of the zinc distilling furnaces, fitted with Kleeman's receivers; (3) the zinc dust of iron blast furnaces. The author treats the above products with a solution of neutral carbonate of ammonia, which should be prepared by dissolving 230grm. of commercial carbonate in 180cc. caustic ammonia of 0·92 sp. gr., and diluting to one litre (H. Rose). By this solution all metallic zinc, oxide, and basic sulphate are dissolved, while cadmium and lead oxide, lead sulphate, and lime sulphate are decomposed and converted into insoluble carbonates. Iron and manganese when present as protoxides are almost wholly dissolved. Ferric oxide is also attacked. A small quantity of cadmium oxide in *statu nascendi* is also dissolved. The substance is first heated with a small quantity of water to 50° C. to 60° C., digested with the above solution and then filtered; the residue is washed with hot water (to which some of the solvent has been added) until no opalescence is produced with pure water. Should iron or manganese be present in the solution, it is oxidised with bromine, and the precipitate filtered with the original residue. The filtrate is then diluted and boiled until the excess of ammonia is driven off; it is then filtered, and the carbonate of zinc is ignited and weighed as zinc oxide, or it can also be estimated volumetrically with sodium sulphide in the original solution, for which purpose it must be divided into two parts, one of which is reserved for the estimation of sulphuric and arsenic acids. The filtrate from the zinc precipitate is divided into two parts, in one of which, after acidifying, the arsenic is precipitated with H_2S; in the other, also acidified, the sulphuric acid is estimated with barium chloride. The residue is dissolved in dilute acetic or hydrochloric acid, and filtered (residue silicate, coke, etc.). In the filtrate, lead, cadmium, iron, aluminium, manganese, lime, and magnesia are estimated in the usual way. The metallic portion of the ash is estimated by means of cupric sulphate, by which zinc and cadmium are dissolved, and copper precipitated. The operation is conducted as follows: To a solution of weighed copper sulphate, so much ash from a weighed portion until the colour disappears, the entire precipitation of the copper being verified by H_2S.—F. T. S.

A Process for Distinguishing Iron from Steel. Chem. Zeit. viii. 56, 1008.

ACCORDING to D. Sévoz the metal to be examined should, after being washed, be placed in a solution of chromic acid, prepared by decomposing bichromate of potash in concentrated aqueous solution, with an excess of sulphuric acid; after immersion from a half to one minute the metal is taken out, washed, and dried. The soft steels and cast-iron show, after this treatment, a uniform ash-grey colouration. Hard steels become almost black, without any metallic lustre. Puddled iron remains almost white, with a metallic lustre on those parts of the surface which have been filed, while the rest of the surface shows irregular black spots.—F. T. S.

New Books.

TECHNISCH-CHEMISCHES JAHRBUCH, 1883-1884. Ein Bericht über die Fortschritte auf dem Gebiete der chemischen Technologie von Mitte 1883 bis Mitte 1884. Herausgegeben von Dr. RUDOLF BIEDERMANN. Sechster Jahrgang. Mit 279 in den Text gedruckten Illustrationen. Berlin: Verlag von Julius Springer, 1885. Preis, 12 Mark (or 12s).

THIS work is a concise yet admirably arranged repertorium of statistics showing the advance of chemistry as applied to the arts and manufactures during the space of time above defined. It takes the form of an 8vo volume bound in cloth, gilt, with table of contents, followed by one of statistics of the chemical industries in Germany, and another bearing upon the laws and regulations of transit, carriage of goods and chemicals, the laws of patent right, etc., in Germany. The work contains 481 pages of subject-matter, 33 pages of references to new books published in the period above mentioned, relating to physics, chemistry, chemical technology, mineralogy and geology, and miscellaneous branches, also alphabetical indexes (*a*) of names of authors, (*b*) of subject-matter. The general arrangement and mode of treatment of the subject is gathered from the contents, headed as follows: Chapters I. to VII. Metallurgy; VIII. Chlorine and Bleaching Powder, Hydrochloric Acid, Bromine; IX. Sulphur and Sulphurous Acid, Sulphuric Acid; X. Common Salt and the Soda Manufacture; XI. Potassium Compounds; XII. Ammonia; XIII. Alkaline Earths; XIV. Alum; XV. Glass; XVI. Earthenware; XVII. Lime and Cements; XVIII. Artificial Stone; XIX. Explosives; XX. Illuminants; XXI. Fuel and Heating; XXII. Sugar; XXIII. Starch and Starch-sugar; XXIV. Wine; XXV. Beer; XXVI. Spirits; XXVII. Fats, Resins, Oils and Soaps; XXIX. Foods; XXX. Manures; XXXI. Tanning; XXXII. Glue; XXXIII. Organic Acids; XXXIV Alkaloids; XXXV. Textiles, Cellulose; XXXVI. Colouring Matters; XXXVII. Paper; XXXVIII. Photography; XXXIX. Apparatus; XL. New Books (Bücherschau).

FRESENIUS' QUANTITATIVE ANALYSIS, Vol. II. Translated by CHAS. E. GROVES, F.R.S. Part I. Price 2s. 6d.

THIS work, appearing in parts and bound in pamphlet form, 8vo size, is a translation of the German edition at present in course of issue from the pen of Prof. Fresenius of Wiesbaden, which has reached, so far, Part VI. (Lieferung. 6). Mr. Groves has most conveniently arranged the issue of his parts, and the numbering of them, in such wise that they coincide with the German arrangement exactly, so that a faithful reproduction of the work of the veteran German analyst is thus assured. The present issue, or Part I., is devoted to the subject of Organic Analysis, contains ninty-six pages of subject-matter arranged exactly as in the German edition, and interspersed in the text are seventy-five engravings, representing the apparatus used and its arrangement in detail and system for the analytical and other operations for which it is required.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

794 A. Allhusen, London. Improvements in the construction and working of furnaces or apparatus for burning pyrites and for analogous purposes. January 20

813 J. Robertshaw and J. T. Turner, Manchester. Improvements in disinfecting apparatus. January 21

966 H. Kenyon, Manchester. Improvements in ovens or retorts, and connected apparatus for use in the distillation and decomposition of coal shale and other matters. January 23

973 G. S. Hazlehurst, London. Improvements in and apparatus for evaporating and concentrating liquids and depositing their contents. January 23

980 S. B. Darwin, Westminster. Improvements in adjustable dip-pipes and their appendages, used in the manufacture of gas. Complete specification. January 23

1001 J. H. Selwin, London. Improvements in liquid fuel furnaces and their appliances. January 23

1038 C. Bramall, London. An improved compound or lining to be used in lining or constructing smelting and other furnaces. Complete specification. January 24

1162 J. G. Hawkins, Westminster. Improvements in gas retort charging apparatus. January 27

1170 W. Bull and J. Lennox, London. Improvements in machinery or apparatus for pressing or moulding pulverised or other materials into bricks, blocks, or cakes. Complete specification. January 27

1176 H. D. Cunningham, London. Apparatus for cooling cement, flour, and other substances. January 27

1221 W. Kent, Jersey City, United States. Improvements in furnaces. Complete specification. January 28

1350 T. Jefferiss, London. New or improved machinery or apparatus for charging gas retorts. January 30

1360 T. Vaughan Hughes, London, and F. W. Harbord, Bilston, Staffordshire. Improvements in the manufacture of basic plug bottoms and bricks for the interior of Bessemer converters. January 30

1455 T. W. B. Mumford and R. Moodie, London. Improvements in apparatus for separating substances of different specific gravities. February 2

1510 G. Fletcher and W. P. Abell, London. Improvements in centrifugal machines for drying sugar and other crystalline or granular substances. February 1

1541 G. Fletcher, London. Improvements in centrifugal machines. February 4

1615 P. Penn-Gaskell, London. Apparatus for treating fish for producing oil and manure. February 5

1633 G. W. Wilkinson, Birmingham. Improvements in gas kilns for burning glass, china, pottery-ware, and other such like articles. February 5

1667 T. C. Lewis, London. Improved apparatus for generating heat in steam-boiler furnaces. Communicated by F. Yates, Germany. February 6

1767 A. Behr, London. Improved apparatus and process for obtaining cellulose and glucose from wood and other vegetable matter. February 9

1837 W. Davidson, London. Improvements in kilns for drying granular substances. February 10

1891 J. Richmond and T. Birtwistle, London. Improvements in furnaces for treating town and other refuse. February 11

1912 W. Mather, London. Apparatus for steaming in the bleaching of fibres, fabrics, and yarns. Complete specification. February 11

1955 R. Morris and J. Wood, London. Improvements in apparatus for grinding or reducing quartz and other hard or brittle substances. February 12

1956 J. Humphrys, London. Improvements in apparatus for the precipitation of solid matter held in suspension in liquids. February 12

1975 J. Watson and J. L. Spoor, London. Improvements in and connected with kilns employed in the manufacture or burning of Portland cement, and other analogous operations. February 12

1977 H. J. Haddan, Westminster. Apparatus for drying in vacuo. Communicated by E. Passburg, Russia. Complete specification. February 12

1982 W. L. Wise, London. Improvements in apparatus for the decarbonation of carbonate of barium and carbonate of strontium. Communicated by R. Radot, France. February 12

2008 A. Whowell, London. An improved agitator and boiler for bleaching and finishing purposes. February 13

2009 A. Whowell, London. Improvements in or applicable to machinery known as drying tins. February 13

2035 C. Price, London. Improvements in kilns for burning and drying bricks and other articles. February 13

2042 A. G. Arfwedson, London. Improvements in casting ladles for casting iron, steel, and other metals. Complete specification. February 14

2126 W. H. Luther, London. Improvements in vessels or baths for galvanising, tinning, or coating iron or other metal. February 16

2150 W. P. Thompson, Liverpool. Improvements in presses for the extraction of oil or other liquids from substances containing them. Communicated by F. Jourdan. February 17

2169 A. Dempster, London. Improvements in apparatus for purifying coal gas. Complete specification. February 17

2198 J. C. Thompson, London. Improvements in screw presses for extracting oils, and for other purposes. February 17

2221 T. L. Ellis, Glasgow. Improvements in reverberatory furnaces. Complete specification. February 18

2289 A. Wilson, London. Improvements in crucible furnaces. February 19

II.—FUEL, GAS, AND LIGHT.

802 A. J. Boult, London. Improvements in the manufacture of illuminating gas from hydrocarbon or other oils, and in apparatus therefor. Communicated by J. Hanlon, United States. Complete specification. January 20

805 A. J. Boult, London. Improvements in the manufacture of gas for illuminating or other purposes, and in apparatus therefor. Communicated by J. Hanlon, United States. Complete specification. January 20

815 H. J. Haddan, London. Improvements in apparatus for and the method of utilising heat developed by combustion. Communicated by W. M. Jackson, United States. Complete specification. January 20

915 F. J. Jones, Bewdley, Worcestershire. Improvements in the production of combustible gases from finely pulverised coal, peat, wood sawdust, or other material. Complete specification. January 22

920 T. Wright, Halifax. Improvements in the means or method of utilising the waste heat and gases arising from steam-boiler furnaces. January 22

967 H. Kenyon, Manchester. Improvements in the distillation and decomposition of coal, shale, and other matters, to obtain illuminating gas and other products. January 23

1026 J. Hanson, Bingley, Yorkshire. Improvements in the method of and apparatus for purifying coal gas. January 24

1081 J. Reid, Birmingham. The revivification of hydrate of lime after it has been used once for the purification of gas. January 26

1400 J. Watson, London. Improvements in the application of gas fuel to boilers for heating purposes. January 31

1958 R. Punshon and S. H. Beckles, London. Improvements in the chemical treatment of hydro-carbons. February 12

2076 G. Gruber, London. Kindling stuff (Phœnix composition). Complete specification. February 11

2190 A. Gutensohn, London. Improvements in obtaining gas from hydrocarbons. February 17

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

967 H. Kenyon, Manchester. Improvements in the distillation and decomposition of coal, shale, and other matters, to obtain illuminating gas and other products. January 23

IV.—COLOURING MATTERS AND DYES.

1553 H. E. Newton, London. An improved process for the production of chlorinated dimethylparaphenylenediamines and the conversion of the same into blue colouring matters containing sulphur. Communicated by R. Mohlau, Germany. February 4

1643 I. Levinstein, Manchester. Improvements in the manufacture of colouring matters suitable for dyeing and printing. February 6

2206 H. J. Haddan, Westminster. Process or processes for the production of soluble combinations of certain azo compounds with bisulphites, and for utilising the same in dyeing and printing. Communicated by Dr. E. Frank and the Farbenfabriken Vormals Bayer & Co., Prussia. Complete specification. February 17

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

1232 W. L. Wise, London. Improvements in means for rendering fabrics and other substances uninflammable, obnoxious to vermin, resistant to putrefaction, to the reception of morbid or diseased matter, and to the growth of spores, fungi, bacteria, etc. Communicated by J. F. Notz and F. Konrad, Saxony. January 28

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

1127 J. Midgley, Shipley, Yorkshire. Dyeing yarns by a specially prepared apparatus. January 27

VII.—ACIDS, ALKALIS, AND SALTS.

800 H. W. Deacon, F. Hurter, and W. Elmore, London Improvements in the treatment of sulphides in alkaline solutions by electrolysis. January 20

1013 F. M. Lyte, London. Improvements in the manufacture of aluminate of soda. January 23

1659 C. W. Watts, Birmingham, and C. F. Claus, Wimbledon, Surrey. Improvements in the treatment of solutions of sulphocyanides in order to obtain useful products therefrom. February 6

1723 W. H. Higgin, Little Lever, Lancashire. Improvements in the manufacture of bichromate of soda. February 7

1868 W. R. Lake, London. The protection of nitrate of ammonia against deliquescence. Communicated by R. S. Penniman, United States. Complete specification. Feb. 10

1900 E. K. Muspratt and G. Eschellmann, London. Improvements in the manufacture of magnesium chloride. February 11

1937 E. W. Parnell and J. Simpson, Liverpool. Improvements in the recovery of ammonia in the manufacture of carbonate of soda by the ammonia process with production of sulphuretted hydrogen. February 12

1971 J. H. Johnson, London. Improvements in the manufacture of caustic baryta. Communicated by H. Kessler, France. February 12

2018 A. McDougall, Penrith. Improvements in the methods of obtaining hydrochloric acid in the manufacture of soda from sodium chloride by the ammonia process. Complete specification. February 14

2193 F. Barbe, London. An improved method of solidification of phosphoric acid by a mineral or a vegetable substance, being porous bodies. February 17

2283 G. A. Jarvis, London. Extracting potash from felspar or felstone rocks. February 19

VIII.—GLASS, POTTERY, AND EARTHENWARE.

1148 J. G. Muller, London. Improvements in the manufacture of tiles and other objects in imitation of majolica ware. February 2

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

833 W. R. Lake, London. An improved process and apparatus for treating wood, chiefly designed for the preservation of railway sleepers. Communicated by E. Z. Collings and C. F. Pike, United States. Complete specification. January 20

884 B. J. B. Mills, London. A process for the agglomeration or consolidation of materials, and for the hardening of stone, cements, and other materials. Communicated by C. Laboré, France. January 21

897 A. J. Boult, London. Improvements in the manufacture of tiles and other articles from plastic materials, and in apparatus therefor. Communicated by F. C. A. Meier, Germany. Complete specification. January 21

910 J. A. Graham, Liverpool. Improvements in drying bricks and other articles, and in plant or apparatus therefor. January 22

1382 H. C. de Berenger, London. Improvements in plaster ceilings and walls. January 31

1778 J. Tomlinson, London. Improvements in the manufacture of plaster or cement. February 9

2095 J. Doulton, London. Improvements in fireproof floors. February 14

2153 L. A. Brode and T. T. Rankin, Glasgow. The manufacture of an improved hydraulic cement. February 17

2161 H. Faija, London. Improvements in the mode and means or apparatus for treating slurry or slip in the manufacture of Portland cement and bricks. Complete specification. February 17

X.—METALLURGY, MINING, ETC.

870 J. H. Johnson, London. Improvements in the manufacture of metallic alloys. Communicated by the Société Anonyme "Le Ferro-Nickel," France. January 21

1020 Peter Kirk, Manchester. Improvements in the production of rolled metal sleepers for permanent way. Jan. 24

1031 E. von Püttner, Liverpool. Improvements in the extraction of magnesium. Complete specification. January 24

1036 H. Hall, London. Improvements in the method of coating metal plates with tin and other metal. January 24

1164 P. Jensen, London. An electrolytical process for obtaining, separating, and cleansing certain metals and alloys, and removing coatings thereof from other metals. Communicated by Dr. O. Kersten, Germany. January 27

1259 E. Glatzel, Halifax. A process for making use of zinc refuse. January 29

1266 J. Head, London. A mode of dividing steel blooms and apparatus for carrying the same into effect. January 29

1305 C. A. Faure, London. Improvements in the manufacture of sodium and potassium. January 29

1338 L. Q. Brin and A. Brin, London. Improvements in the manufacture of ferro-nickel, an alloy of nickel and iron; applicable also to the refining of nickel. January 30

1361 E. Melan and N. A. J. Contarini, London. Improvements in the mode of and apparatus for the manufacture of steel from cast iron. January 30

1369 P. Kirk, Manchester. Improvements in the production of rolled metal sleepers for permanent way. January 31

1376 H. Garner, Birmingham. Improvements in segmental metallic cores to be used in the casting of metals. January 31

1573 G. Lowe and H. Levetus, Birmingham. An improved alloy for mercurial gilding. February 5

1866 G. Rowell, London. Improvements in the manufacture of iron and steel. February 10

1917 W. R. Lake, London. An improved process for annealing copper or its alloys. Communicated by W. Wallace, United States. Complete specification. February 11

1931 R. Schliwa, L. Gildemeister, and R. Feldtmann, Glasgow. Improvements in treating iron in the Bessemer converter or similar apparatus, for the elimination of silicon, phosphorus, and sulphur, and for the formation of slags containing phosphoric acid soluble in water. Complete specification. Feb. 12

2025 L. Q. Brin and A. Brin, London. Improvements in separating metals from their ores, refining metals, and making alloys of metals, and analogous operations. February 13

2196 R. Hadfield, London. Improvements in the manufacture and treatment of tool steel. February 17

XI.—FATS, OILS, AND SOAP MANUFACTURE.

1080 W. G. Little, Rotherham, Yorkshire. Improvements in the manufacture of soap and disinfectants. January 26

1191 W. P. Thompson, Liverpool. Improvements in the process of pressing oil seeds (or other oleaginous matters, or matters containing other liquids) for the purpose of extracting such oil or liquids therefrom, and in apparatus therefor. Communicated by E. Torelli, Italy. January 28

1351 J. Dinning, London. A detergent composition for removing old paint, varnish, or paper and rust, or other impurities from wood, plaster, or other surfaces. January 30

1399 W. G. Radley, London. Improvements in the preparation of oils for medicinal purposes. Complete specification. January 31

2100 H. H. Lake, London. An improved method or process of purifying fat and oil. Communicated by J. P. A. Larson, Sweden. Complete specification. February 14

2210 C. T. Kingzett, London. Improvements in the production of compounds which may be usefully employed for the destruction of insects on plants and animals; also as lubricants; also for sheep dipping; and generally as soaps or detergents for washing, cleansing, and purifying purposes. February 17

XII.—PAINTS, VARNISHES, AND RESINS.

996 J. C. W. Stanley, London. Improvements in the manufacture of pigments or colours. January 23

1103 H. Rees, Wandsworth, Surrey. A method of making crystallised colours, and for receptacles to hold the same ready for use. January 26

1604 T. J. Pearce and M. W. Beardsley, London. Improvements in rendering substances impermeable to air and liquids; in imparting to wood, metal, leather and rubber, animal and vegetable fibre, and fabrics and products thereof, waterproof and weatherproof qualities, and the property of resisting acids and alkalies, in coating and covering electric wires and conductors to insulate them; in rendering submarine structures proof against rot and decay, and the attacks of marine animals; and in the production of a compound suitable for use as a paint, and a protective and preservative coating. February 5

2014 H. J. T. Ford, London. Preservative composition for the bottoms of iron ships and steam boats. February 13

2070 A. C. Bagot, Rugeley, Staffordshire. An improved composition for preventing rust on metals. February 14

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

2026 T. Macdonald and S. L. Evans, London. Improvements in the manufacture of leather. February 13

XIV.—AGRICULTURE, MANURES, ETC.

1835 J. Ross, London. An improved method of treating scrap and old leather for the purpose of manufacturing manure. February 10

2282 G. A. Jarvis, London. Improvements in agricultural manures. February 19

XV.—SUGAR, STARCH, GUM, ETC.

865 A. G. Wass, London. The improved utilisation of sugar scum. January 21

990 W. Smartt, London. Improvements in the preparation of vulcanised India-rubber, and the several analogous substances for attaching to boot soles and other surfaces. Jan. 23

1356 C. & J. Lyle, London. Improvements in the manufacture of lump sugar. January 30

1453 H. J. Haddan, Westminster. Improvements in the process of extracting saccharine matters. Communicated by K. Trobach, Germany. February 2

1972 C. A. Day, Holborn, London. Improvements in means and apparatus for bleaching sugar. Communicated by E. O. Foster, United States. Complete specification. February 12

XVI.—BREWING, WINES, SPIRITS, ETC.

1032 J. Death, junr., Cheshunt, Hertfordshire. Improvements in preparing gelatinised grain for use in brewing. January 24

2078 W. H. Beck, London. A new or improved artificial froth or head for use in the fermentation of fermentable liquids. (Marc Marcus, France.) February 14

2208 W. R. Lake, London. Improvements relating to the preparation of food for animals from the refuse of breweries or of starch and glucose factories and apparatus therefor. Communicated by F. W. Wiesebrock, United States. Complete specification. February 17

XVII.—FOOD PRESERVING, MEATS, Etc.

1531 C. Russell, Tooting, Surrey. Preserving meat. Communicated by A. Losasso, Calcutta. Complete specification. February 4

1550 P. M. Justice, London. Improved process of treating meat, apparatus therefor, and product derived thereby. Communicated by G. Holgate, United States. February 4

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, Etc.

777 W. P. Thompson, Liverpool. Process for sterilising liquids and apparatus therefor. Communicated by H. Danvers and C. Beretta, France. January 20

830 J. Hanson, London. Improvements in softening water. January 20

900 F. M. Lyte, London. Improvements in purifying and deodorising sewage and other foul waters, and obtaining a useful product therefrom. January 21

908 G. H. Ellis, Exeter. A new or improved process for the manufacture of a filtering, deodorising, and decolourising substance or medium from carbonaceous or lignite clay. January 22.

1111 W. E. Gedge, London. A process of purifying water for domestic and industrial purposes and apparatus therefor. Communicated by Fedor Wolff and Co., Germany. Jan. 27

1580 A. B. Lorenz, Beverley, Yorkshire. Preventing water in reservoirs and pipes becoming stagnant and creating gases or becoming otherwise prejudicial to health. February 5

1748 A. J. Shilton, Birmingham. A new disinfectant. Feb. 9

1766 P. Smith and J. T. Smith, Anerley. An improved process and apparatus for evaporating sea water, specially applicable for supplying marine boilers. February 9

2011 J. Horne and S. Hollyman, London. Improved means and appliances for treating foul and noxious gases and vapours for the ventilation of sewers, drains, houses, rooms, and other places. February 13

2167 M. Maloin, London. An improved method of exhausting sewer gas from sewers or drains, and consuming or deodorising and disposing of the same. February 17

2173 T. Kay, Stockport. A method of and apparatus for making sea water drinkable. February 17

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

1006 C. A. Day, London. Improvements in the manufacture of vanilline. Communicated by A Scheidel, Italy. January 23

XXI.—EXPLOSIVES, MATCHES, Etc.

1527 M. Ingram, Manchester. Improvements in railway and other signals for use during fog, snow-storms, or darkness. February 4

2139 A. Favièr, France. New explosive compounds. Complete specification. February 16

*ENGLISH PATENTS PUBLISHED.**

APPLIED FOR DURING 1884.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

2368 H. Hargreaves, W. Beckett, and W. Cliffe. Constructing kilns and ovens for burning limestone and bricks, and other like materials. 6d

3839 G. Patchett, J. Dixon, and R. Teasdale. Means or apparatus for the manufacture of bricks, paving blocks, or the like, from the slag or scoria of blast furnaces. 6d

4298 A. J. Boult. Communicated by the Schlesische Kohlen und Cokeswerke, Gottesberg. Improvements in regenerative coke furnaces. 2d

4650 H. J. Haddan. Communicated by O. Obermaier, Lambrecht, Bavaria. Apparatus for treating textile materials with liquids or gases. 6d

4879 J. Watson. Improved apparatus to be used in the manufacture or preparation of cement. 6d

4902 W. R. Lake. Communicated by L. Fouque. Apparatus for drying and superheating steam, and for similar purposes. 6d

5267 R. H. Hepburn. Furnaces, and apparatus for supplying steam and air thereto in order to cause more perfect combustion of fuel. 6d

5276 J. Moulson. Apparatus for admitting air to steam-boiler and other furnaces for the consumption of the gases arising therein, and the prevention of smoke. 8d

5288 E. H. Waldenstrom and W. Sumner. Preventing corrosion of metal tubes. 2d

6001 D. Burns. Composition for covering boilers or other vessels or bodies, so as to prevent them losing or gaining heat. 2d

6383 A. Munzinger. Drying apparatus for treating pulp and other substances. 8d

7783 C. Price. Air blast or exhaust kiln, with one or more chambers for burning bricks, pipes, tiles, etc. 2d

9304 W. Weldon. Communicated by A. R. Pechiney et Cie. Furnaces for heating solid substances out of contact with the products of combustion of the fuel employed. 6d

14530 W. P. Thompson. Communicated by J. F. Hanrahan. Arrangement and construction of refrigerating chambers or buildings. 6d

15188 H. H. Lake. Communicated by C. W. Flodgrist. Boilers for use in treating wood or other fibrous materials with acids. 4d

15417 S. Adams. Self-sealing mouthpieces and lids for retorts, stills, and generators, for the production of gas from coal and other substances, also for distillation of liquids, etc. 4d

16048 T. Gillespie. Improvement in blast smelting furnaces. 2d

II.—FUEL, GAS, AND LIGHT.

4698 W. H. Spence. Communicated by F. W. C. Waldeck, The Hague. Method of utilising the waste residues of fuel. 4d

4825 W. P. Wilson. Manufacture of gas for illuminating purposes, and apparatus or means to be employed therein. 6d

5357 H. Springmann. Communicated by Dr. Hipp and Dr. Grunberg. Utilising the waste materials employed for the purification of lighting gas. 2d

5871 F. C. Hills. Treatment of gas-liquor for use in the purification of coal gas. 6d

13579 H. H. Lake. Communicated by R. H. Smith. Method or process of and apparatus for recovering paraffin, stearin, or similar waxlike substances from petroleum or other oil. 6d

15196 A. McDougall. Manufacture of ammoniacal salt, and purification of gas. 2d

16750 H. Green. Means for effecting tight closure of gas retorts. 4d

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

5933 R. Irvine. Distillation of shale coal or the like, for obtaining solid paraffin therefrom. 4d

IV.—COLOURING MATTERS AND DYES.

2666 J. H. Loder. Manufacture of alcohol and alcoholic solutions of colouring matters. 4d

4850 J. H. Johnson. Communicated by H. Caro, Ludwigshafen, Germany. Preparation of halogen derivatives of tetramethyldiamidobenzophenone and analogous ketone bases. 4d

5021 F. Wirth. Communicated by E. Erlenmeyer, Frankfurt-on-Main. Improvements in colouring matters. 4d

5038 J. H. Johnson. Communicated by H. Caro, Ludwigshafen, Germany. Preparation of colouring matters suitable for dyeing and printing from halogen derivatives of tetramethyldiamidobenzophenone and analogous ketone bases. 6d

5458 F. Machenhauer. Manufacture of yellow colouring matters. 4d

5741 J. H. Johnson. Communicated by the Badische Aniline and Soda-Fabrik. Preparation of yellow, orange, and orange-brown colouring matters suitable for dyeing and printing from tetramethyldiamidobenzophenone and analogous ketone bases or their halogen derivatives. 4d

11037 F. W. Renaut. Communicated by C. Collin and L. Benoist. Indigo vats, and vats for dyeing with noir-bleu or with mixtures of noir-bleu and indigo. 4d

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

5317 A. W. L. Reddie. Communicated by Dillies et Cie., Roubaix, France. Treatment of vegetable and other tissues or fibres for the purpose of preserving or waterproofing the same. 4d

VII.—ACIDS, ALKALIS, AND SALTS.

3086 M. Finch, W. Willoughby, J. Willoughby, and S. Willoughby. Method of and apparatus for manufacturing sulphuric acid. 6d

3673 C. Wigg and J. W. Pratt. Manufacture of soda and chlorine. 4d

4195 C. S. Gorman. Manufacture of bichromate of soda. 2d

4811 W. J. A. Donald. Manufacture of chromates and bichromates. 4d

4917 S. G. Thomas. Manufacture of phosphatic salts. 2d

5130 S. G. Thomas. Manufacture of chromic compounds. 2d

5520 W. A. Meadows. Manufacture of sulphate of ammonia. 4d

5948 W. J. A. Donald. Manufacture of chromates and bichromates. 4d

6176 E. Packard, jun. Obtaining certain solutions containing free phosphoric acid. 4d

*Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d
„ 1s. 6d., „ „ 2s. 4d.	1½d.
„ 2s. 4d., „ „ 3s. 4d.	2d.

6750 E. Packard, jun. Manufacturing very pure and rich superphosphates of lime. 4d

6751 E. Packard, jun. Obtaining from native or other phosphate of lime products rich in phosphoric acid and of a high degree of purity. 4d

6752 E. Packard, jun. Obtaining from native or other phosphate of lime products rich in phosphoric acid. 4d

7056 Sir F. C. Knowles, Lovell Hill. Treating sulphides and oxides of metals and obtaining products therefrom. 2d

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

7301 D. H. Brandon. Communicated by D. A. Brown and C. F. Brigham. Asbestos compound for use as boards or sheathing for roofings, car brakes, and for building and other purposes. 4d

11087 J. Farthing and J. H. Lorrimer. Manufacture of artificial asphalte. 2d

16006 J. and H. Musgrove-Musgrove. Fire-proof ceilings and walls for houses and other buildings. 2d

16251 E. Brady. Composition of matter as a substitute for wood, stone, and iron, consisting of clay and vegetable pulp and coal ashes, or either of them, combined and mingled with feldspar and caustic soda, etc. 2d

X.—METALLURGY, MINING, ETC.

2263 J. D. Thomas, T. W. Evans, and J. Gravel. Manufacture of tin and terne plates. 6d

3219 J. Lewthwaite. Improvements in metals and alloys or mixtures of the same. 4d

4865 R. J. Atcherley. Method and apparatus for the amalgamation of free gold. 6d

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NOTICES.

The Executive Council of the Inventions Exhibition, having on the motion of Sir F. A. Abel, C.B., D.C.L., F.R.S., and Chairman of the Juries Commission, kindly allowed to members of the Society the privilege of season tickets at half-price, these may be had upon application, accompanied by remittance of 10s. 6d., to the General Secretary at the Society's Office, Palace Chambers, Bridge St., Westminster, S.W.

Members are hereby informed that the Annual General Meeting (1885) will take place in London in or about the second week in July. Details and arrangements will be published in due course, and members will receive their tickets of membership, which, as heretofore, will form vouchers in visiting works and places of interest.

Authors of papers printed in the Journal are hereby notified of the fact that, in accordance with Bye-law 43, they are entitled to receive not more than 50 gratuitous copies of their papers. Authors should state on their manuscripts their desire to have free copies, adding the number wished for. Unless the contrary be specially desired, this being stated on the manuscript, the reprints of an author's paper will not include the report of any discussion that may have arisen after the reading of the paper.

Members are hereby advised that the Subscription for 1885 falls due at the beginning of the year, and should be paid as soon afterwards as possible. The Council has decided that after January 1st, 1885, the 29th Bye-law will be strictly enforced, so that Members whose subscriptions are more than four months in arrear, will not continue to receive the Society's Journal.

Inquiries having been made as to the transactions of the Newcastle Chemical Society, the Committee of the Newcastle Section have to state that a very few complete sets are remaining, and will be sold to members at £2 10s. per set. A number of separate volumes can also be had by members wishing to complete their sets, at 10s. per volume (generally three years' issue). Application for these should be made to the Local Secretary of the Newcastle Section.

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MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

April 13.—(First Monday *after* Easter)—Mr. W. J. Dibdin—"Further Notes on the 'Radial' Photometer, and the Proposed Standards of Light."
May 4.—Messrs. Giles and Shearer—"The Real Strength of Aqueous Solutions of Sulphurous Acid."
Messrs. C. Napier, Hake, and Mook—"The Stassfurt Salts Industry, and its bearing on other Industries."
Discussion on Professor Munro's paper published in January number of the Journal, "On the Manurial Value of Filter-Pressed Sewage Sludge," read January 5.
June 1.—Messrs. Salamon and W. de Vere Mathew—"The Influence of Phosphates upon Fermenting Worts."
July. The Annual General Meeting.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held March 2, 1885.

SOME EXPERIMENTS UPON THAT PART OF THE PATENT OF MR. F. B. RAWES FOR THE RECOVERY OF SULPHUR, ETC., WHICH DEPENDS UPON THE ACTION OF CARBON-DIOXIDE UPON SODA WASTE OR SULPHIDE SUSPENDED IN A LIQUID.

BY WM. JOEL KEMP.

IN the process in question the reliance is upon carbon-dioxide as the chemical agent for the elimination of hydrogen-sulphide, the carbon-dioxide being applied in the manner detailed in the patent taken out by Mr. Rawes early in the year 1882. It appeared to me that the suspension of the sulphide in a liquid "intermedium," and the systematic agitation specified, were definite, and most important advances upon all previous attempts in the same direction, and therefore the process seemed to claim an especial interest.

My experiments now to be described were carried out during August and September, 1882, and the proposition started with was :—

"Given pure carbon-dioxide to operate with, whether hydrogen sulphide would be produced sufficiently free from admixture with carbon-dioxide to be utilisable as a source of sulphur or sulphuric acid; and whether practically the whole of the sulphur existing as sulphide could be eliminated by the method."

The waste used was partially oxidised, and contained a total of 21·44 parts of sulphur in 100 parts of dried waste, three-fifths of the sulphur being convertible into hydrogen sulphide by treatment with hydrochloric acid.

In making the first experiment a measure of moist waste equal to about 20cc. was divided into three approximately equal parts, and each part placed in a wide-mouthed bottle with some bi-carbonate of soda solution as an "intermedium," the use of an "intermedium" being part of the process alluded to. Each

of the three bottles (Fig. 1) was fitted with a cork pierced with three holes—a larger one in the centre through which passed a glass tube with its lower end dipping into the liquid, and reaching at the upper end to about eight inches above the rim of the bottle. This tube was sufficiently wide to admit of the easy working of a stout wire rod which passed through it, and which was bent at the lower end in such a manner as to form a stirrer.

Through the smaller holes glass tubes were passed in such a way as to represent the usual arrangement of the Woulfe's bottle. The bottles were then connected in series, and the first of the series attached to a Kipp gas generating apparatus charged with marble and hydrochloric acid, and provided with a wash bottle containing water.

The exit tube of the third bottle was connected with two flasks coupled together in series, charged with copper sulphate solution slightly acidulated with sulphuric acid. Next the second flask was a drying bottle containing concentrated sulphuric acid, and then a small weighed flask with caustic potash to retain any CO_2 that might pass over unabsorbed.

The upper end of each stirrer worked in a bearing, and was fitted with a pulley. The pulleys were coupled together by elastic bands, and one of them

These results appeared satisfactory as to the percentage composition of the resulting gases, but the small amount of gas expelled determined me in continuing the experiments to provide for a greater pressure of carbon dioxide, which was accomplished by fitting a tube by a cork into the neck of the Kipp apparatus, to the upper end of which tube was fixed by a pierced cork a cylinder open at the top to serve as a reservoir.

The working of the pullies and stirrers was very much improved, so that in the later experiments it was easy with a current from three Groves' cells to give them a very rapid rotation.

The receiving arrangement was also remodelled as shown in Fig. 3.

The exit tube A from the last desulphurer of the series was bent at an obtuse angle at B, and was kept cool with moistened filtering paper during the experiments to condense any slight amount of moisture. C and D were charged with a known volume of a standard solution of copper sulphate, and were placed in a water bath kept at a temperature of about 40° C. E contained a small quantity of lead nitrate to indicate if any hydrogen sulphide passed the copper sulphate unabsorbed. F was a drying bottle with concentrated sulphuric acid, G with caustic potash to take up the

FIG. 1.

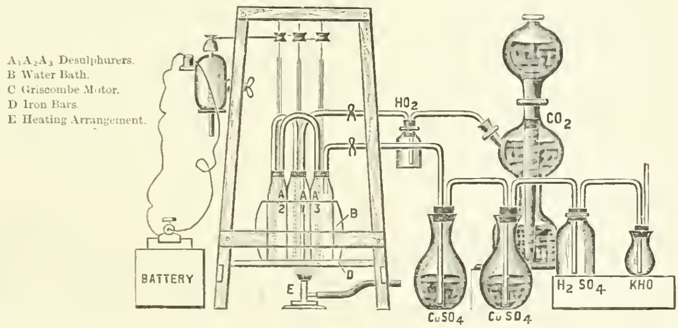

FIG. 2.

attached by the same means, to a small Griscombe (electric) motor. The three bottles, simulating the "desulphurers" described in the patent, were placed in a water bath, provided with a source of heat, the complete arrangement being shown in the accompanying illustration (Fig. 2).

The motor was started and a slow stream of CO_2 admitted, and after some time the copper sulphate solution darkened in colour, and upon heating the water bath to about 45° C. a decided precipitate appeared. The pressure of carbon dioxide was only sufficient to propel a very weak current of gas through the apparatus, and the stirrers worked only slowly, in consequence of the pullies requiring readjustment. After five hours the experiment was stopped, the receivers disconnected from the desulphuring bottles, and a current of air aspirated through the former.

The copper sulphide was then collected on a filter, dissolved, and precipitated with caustic potash, and the copper weighed as oxide. The potash bottle was also weighed, and from the results the respective weights of hydrogen sulphide and carbon-dioxide that were absorbed were calculated as follows :—

H_2S = ·081grams = 96·43 per cent.
CO_2 = ·003 „ = 3·57 „

carbon-dioxide, and in the test tube H was a small quantity of concentrated sulphuric acid to prevent the entrance of carbon-dioxide and moisture from the air.

The receivers C and D were in duplicate, and the duplicates were used alternately in order that it might be possible to wash and dry one set before recharging with copper sulphate solution, during which time the other set could be used. This arrangement was necessary to render it possible to estimate the amounts of the gases evolved at various stages of the operation. The method adopted to estimate the copper sulphide precipitated was as follows :—

After each stoppage the receivers were disconnected from the desulphurers at I, and the exit tube of the latter was plugged. Air was then aspirated through the receiving apparatus C to H, after which the contents of the tube D were added to those of the flask, and the whole shaken up together, and a small portion of the solution quickly filtered through a dry filter. 10cc. were then taken by a pipette from the filtrate, and the copper, after reduction by sulphurous acid, was precipitated by an excess of ammonium thiocyanate. The precipitate being filtered off the excess of ammonium thiocyanate was

estimated by titration with silver nitrate, and the hydrogen sulphide calculated from the results.

In carrying out this method for the estimation of the residual copper, some slight oxidation of the copper sulphide may have occurred during the aspiration, and the filtration of the copper solution; but the error, if any, due to this cause must have been until the issuing gas almost ceased to precipitate any sulphide from the copper solution.

The liquid was then poured off and a portion of the residue, after being washed and dried at 100° C., was distilled with hydrochloric acid, the distillate being received into a solution of copper acetate, which proved that the solid residue was practically

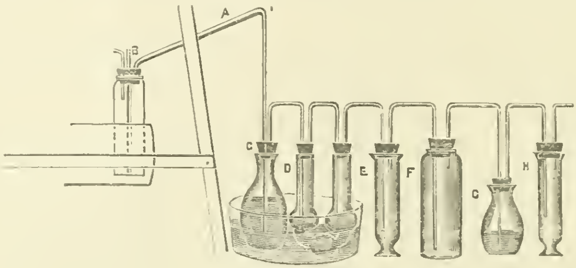

Fig. 3.

insignificant. In the second experiment (*i.e.*, the first under the new arrangement) two desulphuring bottles were employed instead of three, as before; and a larger quantity of waste was operated upon.

A measure (about 20cc.) of the moist waste was placed in each bottle, the bicarbonate of soda solution added, the stirrers rotated, and a current of carbonic anhydride passed in. The results at stated intervals are given in the following table:—

Number of Stoppages.	Number of Hours run.	Weight in grammes of Gases collected.		Percentage composition of Gases collected.	
		H_2S	CO_2	H_2S	CO_2
1	2	·2067	·0217	90·93	9·07
2	1½	·4371	·0200	95·62	4·38
3	1	·3117	·0900	77·76	22·24
4	1	·4530	·1250	78·37	21·63
5	2	·2200	·0200	91·66	8·34
6	3	·1695	·0170	90·88	9·12
7	1	·2968	·0400	88·12	11·88
8	3	·6350	·0700	90·07	9·93
9	2½	·1130	·0100	91·17	8·83
	17	3·1458	·4137	87·63	12·37

The above table shows some remarkable differences in the composition of the escaping gases—for instance, see Nos. 3 and 4, where the percentages of hydrogen sulphide were only 77·66 and 78·37 respectively.

In these cases the battery was weak, and the agitation consequently insufficient to utilise fully the quantity of carbon-dioxide being passed in. This point will be referred to later on. Whilst Nos. 5 and 6, where the gas expelled is small in amount, show that the pressure of carbon-dioxide was weak owing to the need of replenishing the supply of acid in the generating apparatus.

As the residue from this experiment was not exhausted of sulphide, it was further subjected to treatment with carbon-dioxide for nine hours, and exhausted of sulphide, as no precipitate of copper sulphide was formed—a mere trace being indicated by a slight brown colouration at the edge of the copper solution. And this trace was probably due to iron-combined sulphur existing originally in the waste, which would of course not be acted upon by carbon-dioxide.

The next trial was conducted with one desulphuring bottle only, the receiving arrangement remaining as before.

Two measures of moist waste (each equal to about 20cc.) were acted upon with results stated in the following table:—

Number of Stoppages.	Number of Hours run.	Weight in grammes of Gases collected.		Percentage composition of Gases collected.	
		H_2S	CO_2	H_2S	CO_2
1	1	·1713	·029	83·25	16·75
2	1½	·2130	·074	76·65	23·35
3	1	·2762	·121	70·00	30·00
4	1	·2700	·213	56·25	43·75
5	2	·5038	·228	68·85	31·15
6	2½	·6271	·185	77·22	22·78
7	1½	·5742	·188	74·80	25·20
8	2	·4965	·307	61·77	38·23
9	3	·3394	·208	62·00	38·00
10	2	·2216	·120	64·80	35·20
	17½	3·7261	1·673	69·01	30·99

From the above table it will be seen that when approximately the same quantity of waste formerly acted upon in two connected desulphuring bottles, was now operated upon in one, a much larger percentage of carbon dioxide passed through, showing that the distance travelled by the gas in its ascension through the suspended waste has a marked effect upon the respective proportions of hydrogen sulphide and carbon dioxide coming off. As might be supposed,

the deeper the column of "intermedium" (containing a given quantity of waste) the better the result in hydrogen sulphide.

For this reason, and also because a great absorption of carbon dioxide takes place at first starting, it is evident that an arrangement, as suggested by the patentee, which permitted the use of two or more desulphurers in series, and an interchange in their order, would be most desirable. In such a case, the excess of carbon dioxide passing from the first would be utilised by the fresher waste in the second, third, etc. The propriety is also pointed out of having the desulphuring vessels as deep as circumstances will allow.

The next experiment was carried out with a view to ascertain whether, by greatly increasing the number of points of contact between the ascending gas and the suspended particles of waste, a greater current of carbon dioxide could not be forced in without danger of its passing away unabsorbed; and to this end, one desulphuring bottle was charged with five measures (each about 20cc.) of waste and a bulk of intermedium, reaching to the same height as in the previous experiments.

The results obtained were as follows:—

Number of Stoppages.	Number of Hours run.	Weight in grammes of Gases collected.		Percentage composition of Gases collected.	
		H_2S	CO_2	H_2S	CO_2
1	4	·3721	·0515	87·83	12·17
2	2	·1388	·0510	89·55	10·45
3	1	·2150	·0505	81·13	18·87
4	1¼	·9121	·0130	95·51	4·19
	8¼	1·9383	·1960	90·80	9·20

During the first 3 to 4 hours the absorption of carbonic anhydride was very great, and the quantity of hydrogen sulphide expelled comparatively small, owing to the hydrate of lime contained in the waste, which required saturating by the carbon dioxide before the latter could act to any extent upon the calcium sulphide.

This absorption of carbon dioxide had been anticipated, of course, and noticed in the earlier experiments, but in the present case it was more marked, in consequence of the much larger quantity of waste being operated upon.

At this point another desulphurer, similarly charged to the first, was attached thereto, and the experiment continued, the respective weights and proportions of the gases evolved being annexed:—

Number of Stoppages.	Number of Hours run.	Weight in grammes of Gases collected.		Percentage composition of Gases collected.	
		H_2S	CO_2	H_2S	CO_2
1	1	·7310	·019	97·48	2·52
2	⅞	1·2530	·037	97·13	2·87
3	⅝	·9175	·039	96·05	3·95
	2⅞	2·9345	·095	96·85	3·15

From these two last experiments I found, as surmised, that by acting upon a larger quantity of sulphide in a given bulk of "intermedium," it was possible to pass in a larger supply of carbonic anhydride, and consequently to obtain a richer result in hydrogen sulphide, almost free from admixture with carbon dioxide.

It now occurred to me that if, from the small apparatus with which I was working, I could obtain a current of hydrogen sulphide in sufficient quantity to burn from a jet, it would be an attainment not devoid of interest, and to that end I now proceeded to adapt my apparatus as shown in Fig. 4.

Three desulphuring bottles were now charged, each with about the same quantity of waste as in the last experiment, and the gases evolved from the desulphurers were made to pass through three bottles, A, B, and C (all containing solution of normal sodium carbonate), which represent the purifiers designed by the patentee for the absorption of waste carbon dioxide. D, E, and F contained absorbents of hydrogen sulphide, and were used to prevent the escape of the gas, should it not be obtained in sufficient quantity to burn from the jet, as I had no fume closet of sufficient size available. H was filled with dried calcium chloride.

Four cells of a Groves' battery were connected with the motor, which gave the agitators considerable velocity, and a current of carbon dioxide was forced through the apparatus. After a short time, clip K was opened, and, on a light being applied to the platinised burner G, the gas burned freely, with a flame some 2in. to 3in. long.

The experiment was repeated several times with varying degrees of success, and the best results were obtained when the agitation was most efficient.

There was a marked relation between the speed of the agitators and the quantity of carbon dioxide absorbed on the one hand, and of the hydrogen sulphide evolved on the other. As an instance: upon one occasion the agitators were only working at a moderate speed, and under those conditions it was not possible to keep the gas burning on account of the quantity of CO_2 present, my arrangement of normal sodium carbonate solutions not being sufficient to absorb all the carbon dioxide when a strong current of that gas was passing. On putting on, however, an additional cell, which probably doubled the speed of the stirrers, the carbon dioxide was absorbed and the issuing gas burned freely. It is thus evident that the efficiency, or otherwise, of the agitation is sufficient to make all the difference between success and failure.

The short piece of tubing L, surrounding the burner, steadied the flame and prevented its floating away as it was sometimes inclined to do, doubtless through the presence of carbon dioxide. I suppose the piece of outside tubing lessened the dissipation of heat from the burner, so that the gas and air met at a higher temperature than when the tube was dispensed with.

With regard to the application of heat to the desulphurers, it was found that by heating the water bath in which they were to about 45° C., the commencement of the evolution of hydrogen sulphide was accelerated.

In preparing each of the foregoing experiments, the addition of the bicarbonate of soda solution to the waste caused an immediate evolution of hydrogen sulphide, showing, I think, that the view is correct that the bicarbonate acts as a carrier of carbon dioxide to the sulphide.

Remembering that my method of passing in the gas, although as convenient as I could readily adopt, is not to be compared in point of efficiency with

arrangements that could be made with apparatus upon a larger scale, and taking this into consideration, together with the results obtained, it must, I think, be confessed that the action of carbon dioxide upon soda waste, under the conditions prescribed by Mr. Rawes, is a question of considerable interest.

Although I have spoken above of the action of carbon dioxide upon calcium sulphide, I have not overlooked the researches of Dr. Divers and others upon the changes which take place in alkali waste, etc., but I have sought simply to give the practical results of my experiments, leaving out of consideration, at the present time, those intermediate steps by which the final results may have been attained.

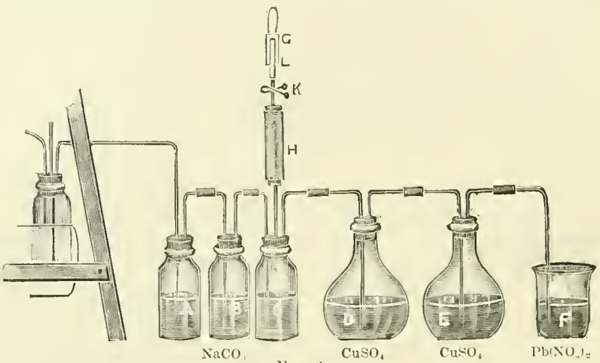

FIG. 4.

The present investigation being very incomplete on certain points, it was intended to have followed it up by other experiments calculated to throw light upon the question as to the best temperature at which to keep the desulphurers, and, again, others to show the differences in composition of both the solid and liquid contents of the bottles, before and after treatment of definite amounts of waste and intermedium, with definite quantities of carbon dioxide, for definite periods of time, etc.

Pressure of work, however, in other directions has, so far, prevented these intentions being carried out.

DISCUSSION.

Mr. CRESSWELL said, that the weak point in Mr. Kemp's interesting paper consists in his silence as to efficient means for procuring that pure carbonic acid on a commercial scale on which he relies for his reaction. Without such provision the practical aspect of the paper would at once disappear. He might inform the meeting that while working the Schaffner and Helbig process at Messrs. Chance's Works, sulphuretted hydrogen had been made on such a large scale that it had been used in flames sometimes more than a foot long for making chamber acid, and burnt as freely as coal gas. In decomposing waste by limekiln or flue gases this direct burning was impossible, and a supplementary process such as that of Mr. Claus' became necessary.

THE TREATMENT OF CERTAIN PHOSPHATIC MINERALS OF THE TYPE KNOWN AS "REDONDA" PHOSPHATES.

BY W. J. WILLIAMS.

IN 1878 the problem was laid before me of how to deal with the phosphates of alumina and iron known as "Redonda" phosphate, so as to produce therefrom marketable products.

Two methods at once suggest themselves: (*a*) solution in mineral acid, (*b*) furnacing with alkalies or alkaline salts.

In considering the possibilities of solution the solvents are practically reduced to two—viz., hydrochloric and sulphuric acids.

Hydrochloric acid was quickly dismissed, as this acid *dissolves* the phosphate but does not *decompose* it, and on neutralisation of the acid solution, phosphate of alumina and iron is simply re-precipitated. The only advantages derivable from this method of treatment are, first the siliceous matter can be separated by decantation, and second, the phosphate of alumina and iron is re-precipitated in a very finely divided condition.

Treatment with *Sulphuric Acid.* In this method I was unable to devise any improvement on the well-known process of the late Mr. Peter Spence, who dissolves in moderately strong sulphuric acid, separates from the siliceous matter by decantation or filtration through sand, adds ammonium or potassium sulphate in the necessary proportions, and then crystallises out the alum thus produced, leaving a mother liquor of phosphoric acid mixed with sulphuric acid. It is, however, very difficult to separate the whole of the alum by crystallisation from this strongly acid solution; many devices for obtaining thorough crystallisation were only partially successful, and in consequence the mother liquor of phosphoric acid is largely contaminated with sulphuric acid and considerable quantities of alumina. The alum obtained contains too much iron for the market, which renders its disposal a difficult matter.

Other methods are known for the treatment of "Redonda" by concentrated sulphuric acid, leaving the alumina and iron in an insoluble condition and separating phosphoric acid more or less mixed with sulphuric acid, but on investigation these did not give sufficient encouragement to warrant adoption, as by these processes the alumina does not seem obtainable in a marketable condition.

The "solution" processes in acid being thus eliminated, I then turned my attention to alkali.

Solution in caustic soda promised well, as sodic aluminate and sodic phosphate are formed, the iron oxide and sand being left as an insoluble residue. This method had to be abandoned, as it is covered by former patents; further, the costliness of the solvent was a serious obstacle to its commercial success.

I then turned my attention to "fusion" or furnacing methods.

The published patents of these "furnacing" methods are very numerous. They include furnacing with sodium hydrate, sodium carbonate, and sodium sulphate with and without silica, carbon, and other additions. Furnacing with sodium sulphate (salt cake) and coal was well known to me, having taken out letters patent for such a process some years before, when dealing with a kindred phosphate of alumina and iron known as "Alta Vela" phosphate.

Before going into the details of furnacing processes it is now time to consider the preparation of the raw mineral. Intimate mixture with the alkaline salt is, of course, of great importance, which necessarily pre-supposes fineness of division. "Redonda" is of a very porous texture and generally contains from 20% to 25% of moisture and combined water. In this raw state it is difficult to grind, as it binds and chokes the mills. This objection is obviated by first calcining or roasting it. There are of course many ways of performing this, but as only a low red heat is required the most economical method is the following. The rough rock mixed with about 10% of fuel, preferably coke, is thrown into a vertical cylindrical cupola, this calcines freely and thoroughly, splitting up into small lumps, which are friable, and can be ground to any desired degree of fineness through French stones; for furnacing purposes, however, it is quite sufficient to pass the calcined "Redonda" through ordinary "edge runners," together with the alkaline salt and coal or coke if required. This gives a sufficiently finely-ground and intimate mixture for practical purposes.

The intimately mixed materials, "Redonda," saltcake and coke are then thrown into a reverberatory furnace and roasted until the mass begins to "set" and get "sticky." This operation is analogous to the "black ash" operation of the Leblanc process, and takes about the same time, two hours being sufficient for each charge, about three-quarters of an hour on the "back" and one and a quarter on the "front" bed of the furnace. It requires, however, more attention from the workman, for as the mixture does not fuse together or "ball" it must be turned over at frequent intervals, so as to continually expose fresh surfaces to the action of the flames. When drawn it is a little "sticky," but on cooling breaks up into small lumps; indeed, it might be more accurately described as coarse powder. Towards the end of the furnacing operation the fire must be urged fiercely and air admitted freely that the sulphur may be oxidised to sulphurous acid and driven off, otherwise the sulphides become a serious nuisance in lixiviation. The finished charge should also be allowed to cool before being transferred to the vats. The sulphurous acid is utilised as shown below.

This method of furnacing with saltcake and coke produces, when the furnaced ash is lixiviated, a solution of tri-sodium phosphate and sodium aluminate, according to the following equation :—

$$AlPO_4 + 2(FePO_4) + SiO_2 + 6(Na_2SO_4) + 6C$$
$$= Na_3AlO_3 + 3(Na_3PO_4) + 6SO_2 + 6CO + SiO_2 + Fe_2O_3,$$

leaving in the lixiviating vats an insoluble residue of sand and ferric oxide.

In this way the phosphoric acid is separated as tri-sodium phosphate and the alumina as tri-sodium aluminate, but now arises the question, "What is the value of these products?" As they stand they are unmarketable except in comparatively small quantities. It is obvious then that they must be converted into saleable articles, say alumina hydrate and calcium phosphate.

First I will deal with the alumina.

Originally I purposed treating the mixed solution of tri-sodium aluminate and tri-sodium phosphate directly with the sulphurous acid gas evolved from the furnace, precipitating alumina as hydrate and reducing the tri-sodium phosphate to di-sodium-hydrogen phosphate, with formation of sodium sulphate, according to the equation :—

$$2(Na_3AlO_3) + 2(Na_3PO_4) + 4(SO_2) + H_2O$$
$$= Al_2O_3 + 2(Na_2HPO_4) + 4(Na_2SO_3),$$

and filtering off the alumina hydrate. This, however, did not answer, for I found that instead of obtaining alumina hydrate, a retrograde action took place, the phosphoric acid re-combining with the alumina, and a mixture of alumina phosphate with alumina hydrate was precipitated. The proportion of phosphoric contained in this mixture of alumina phosphate and hydrate varied considerably, but was always above 24%. Whether the lye from the vats was taken highly concentrated at say 60° Tw., or diluted down to even 10° Tw., still the alumina precipitated invariably contained phosphoric acid. This difficulty was finally overcome by the expedient of crystallising out the tri-sodium phosphate from the "vat liquor," and having thus separated the tri-sodium aluminate, treating it with the sulphurous acid gas from the furnace and precipitating the alumina hydrate. The quantity of phosphoric acid precipitating along with the alumina hydrate was, of course, dependent on the completeness of the crystallisation of the tri-sodium phosphate. By a second crystallisation, or in other words, concentrating the mother-liquor from the first crystallisation, and again crystallising out the tri-sodium phosphate, a mother-liquor of tri-sodium aluminate was obtained containing only 1·5% to 1·2% of the phosphoric acid *originally in the vat liquors*, or about 98% of the tri-sodium phosphate could be crystallised out of the vat liquor.

The tri-sodium aluminate thus obtained was then treated with the sulphurous acid gas from the furnaces by means of ordinary condensing towers, which were carefully packed with flints. The sodic aluminate liquor was forced to the top of the towers and allowed to percolate through the flints, where it met the ascending stream of sulphurous acid gas, which reacted on the liquor, precipitating alumina and leaving sodium sulphite in solution. The towers were very carefully packed, so that the precipitated alumina should not choke up the interstices between the flints, but practically there was little difficulty in keeping them clear. The alumina was then filtered at 90 to 100lb. pressure and washed in filter-presses, and dried by steam heat under a partial vacuum at a temperature not exceeding 240° F. or 116° C. It was found to be practically impossible to wash the alumina completely free from soda salts, either in the washing presses, or by agitating the alumina with successive doses of water and re-filtering.

The sodium sulphite was evaporated to dryness and utilised for fresh furnacings.

TRI-SODIUM PHOSPHATE.

The sale for this product is very limited. It was therefore decided to convert this into calcium phosphate. But this conversion could not possibly be a commercial success unless the soda were recovered in at least as valuable a form as that in which it was used for furnacing. Therefore the obvious method of treating the tri-sodium phosphate with calcium chloride, with production of sodium chloride, was out of the question.

The method of using freshly-burned lime after the manner of "causticising" was experimented with for a considerable time on the laboratory scale; taking all due precautions for obtaining well-burned lime free from carbonate, it is possible to produce a high strength calcium phosphate, containing phosphoric acid

equal to from 90 to 95% tri-calcium phosphate and a thoroughly causticised solution of soda. On the manufacturing scale this was, however, found to be impossible. The best results were obtained by the device of "repeated treatments;" that is, each batch of phosphate of soda liquor was treated successively with three doses of lime, and each charge of lime was treated in turn with three successive doses of phosphate liquor, in such a way that the partially causticised liquor was finally treated with fresh lime, and the partially phosphated lime was finally treated with strong sodium phosphate, so that in the case of the liquor there was a very large excess of caustic lime, CaO, and in the case of the lime there was a very large excess of sodium phosphate present in the final treatments. In this way the liquors were fairly well causticised, but the precipitate could not be completely phosphated, the results averaging about 34% phosphoric acid, equal to 74% tri-calcic phosphate. This precipitate always contained a large proportion of *calcium carbonate*, even when the process was conducted in closed vessels and freshly and thoroughly burned lime was carefully chosen. Working in closed vessels under pressures varying up to 40lb. per square inch did not improve matters.

The use of chalk, with or without pressure, gave no better results, the average being much the same as with burnt lime. As this 74% phosphate was little better than natural phosphates, it was not considered satisfactory.

The next trial was made with calcium sulphate as gypsum. This gave somewhat better results than either lime or calcium carbonate, giving a product of from 80% to 85% tri-calcium phosphate when dried, the liquor resulting from the decomposition being, of course, sodium sulphate.

Using solid matter in suspension in water, such as lime, chalk, or gypsum, it appeared as though it were impossible to get a sufficiently intimate admixture of the sodic phosphate liquor and the suspended lime or lime-salt, so as to get thorough re-action and complete decomposition. It then became a question as to what soluble calcium salt would best produce a high-strength calcium phosphate, and at the same time produce a soda salt either of the same commercial value as salt-cake, or one that would serve equally well for future use in the furnacing operation. As before mentioned, calcium chloride was out of the question.

My friend, Mr. W. A. Hills, then suggested the use of the soluble calcium di-sulphides, obtained from old oxidised "vat waste" or "alkali waste." I have made several experiments with the "yellow liquor" produced by treating old "alkali waste" with water, but the calcium phosphate formed was always contaminated with more or less sulphur. This led me to consider the idea of "blowing" or further oxidising the "alkali waste" until the di-sulphides were converted in hypo-sulphites or thio-sulphates. In the oxidising process for the recovery of sulphur, the waste is blown until the calcium sulphides is converted into di-sulphide and thio-sulphates, but for this purpose I continued the "blowing" or oxidation until the di-sulphides were converted to the fullest practicable extent into thio-sulphates, and on lixiviation yielded, not the "yellow liquors" of the sulphur recovery process, but a colourless solution of calcium thio-sulphate. If on lixiviation of the oxidised alkali waste it was found that the liquors still contained any appreciable quantity of calcium di-sulphide, then sulphurous acid gas was forced into the liquors until the di-sulphide was converted, thus—

$$CaS_2 + SO_2 + H_2O = CaS_2O_3 + H_2S.$$

This solution of sodium thio-sulphate re-acts perfectly on a solution of tri-sodium phosphate, producing a tri-calcium phosphate of about 96% and sodic thio-sulphate, which on evaporation can be utilised for furnacing.

Here I may call attention to a somewhat remarkable re-action noticed during the experiments, which will, I believe, be novel to many. As before remarked, it was originally intended to treat the vat liquors directly with sulphurous acid gas from the furnace and thus precipitate alumina, at the same time reducing the tri-sodium phosphate to di-sodium-hydrogen phosphate and forming sodium sulphite, but this method was afterwards abandoned when it was found that alumina phosphate was precipitated with the alumina hydrate. While working on this principle, however, another difficulty arose, caused by this peculiar re-action. The mixture of sodium sulphite and di-sodium-hydrogen-phosphate was treated in the ordinary way with a sufficient quantity of calcium thio-sulphate to form di-calcium phosphate, on the supposition that the calcium thio-sulphate would decompose the di-sodium-hydrogen-phosphate, but would have *no* action on the sodium sulphite, thus precipitating di-calcium phosphate and leaving a mixture of sodium sulphite and thio-sulphate. This re-action did indeed occur, but it was accompanied by a re-action between the sodium sulphite and the calcium thio-sulphate, precipitating calcium sulphite and forming sodic thio-sulphate, so that a mixture of calcium sulphite and di-calcium phosphate was precipitated, leaving sodium thio-sulphate in solution, thus—

$$Na_2SO_3 + Na_2HPO_4 + 2(CaS_2O_3) = CaSO_3 + CaHPO_4 + 2(Na_2S_2O_3).$$

As a mixture of calcium sulphite and di-calcium phosphate is of no great market value, some method had to be adopted to prevent this production of calcic sulphite. This was effected by injecting air through the mixed sodium sulphite and di-sodium hydrogen phosphate until the sodium sulphite was "blown" to sodium sulphate, which is not decomposed by calcium thio-sulphate, the re-action then taking place being—

$$Na_2SO_4 + Na_2HPO_4 + CaS_2O_3 = CaHPO_4 + Na_2S_2O_3 + Na_2SO_4.$$

The di-calcium phosphate was then filtered and washed, and the mixed sodium sulphate and thio-sulphate evaporated to dryness for future use.

When it was found that the tri-sodium phosphate must be separated from the sodium aluminate by crystallisation this difficulty was partially obviated, as to produce tri-calcium phosphate it was only requisite to re-dissolve the crystals and treat the solution with the proper proportion of calcium thio-sulphate to supply three equivalents of calcium for each equivalent of phosphoric acid present. If di-calcium phosphate, however, was required, then the solution of the tri-sodium phosphate crystals was reduced to di-sodium hydrogen-phosphate by the sulphurous acid gas, the sodic sulphite oxidised by injected air to sodic sulphate, and the mixture of di-sodium-hydrogen-phosphate and sodium sulphate treated with sufficient calcium thio-sulphate to supply two equivalents of calcium for each equivalent of phosphoric acid. The di-calcium phosphate was then filtered at 90lb. pressure and well washed, and there was no difficulty in washing this precipitate practically free from soda salts. The phosphate was then dried, like the alumina hydrate, by a steam heat under a partial vacuum, temperature not exceeding 240° F. or 116° C. By these processes the alumina is obtained as hydrate, and the phosphoric acid as di-calcium phosphate, with recovery of soda as sodium sulphate sulphite and thio-sulphate, which, when evaporated to dryness, are available for use in future furnacings.

This process, however, had certain objections. First, there was the carriage of alkali waste; then

in shooting the waste into the vats (furnished with perforated false bottoms for "blowing" or oxidising) it was found that it clogged and caked in masses, so that the air could not penetrate equally through the bulk, and consequently large quantities entirely escaped oxidation; so that, as a practical result, the quantity of lime obtained as calcium thio-sulphate was about 15% to 20% on the total alkali waste. This small yield was only attained by a heavy outlay in labour, and rendered the process practically inoperative unless it could be carried on in close contiguity to an alkali works, where the waste could be "blown" without removal from the vats. Not only does this save the labour of moving the waste, but, owing to the porous or honeycombed condition in which the waste is left, it permits free access of air all through the mass, so that the sulphides are more completely oxidised, and the proportion of soluble calcium thio-sulphate obtained is larger.

While this method was being elaborated I carried out numerous experiments for obtaining a re-action between the "Redonda" phosphate and sodium chloride. Direct fusion of the phosphate of alumina and iron with sodium chloride gave no result beyond a small liberation of hydro-chloric acid gas. It then occurred to me that if free hydrogen were present to combine with the chlorine of the salt a re-action might be established, which proved to be the case.

The cheapest and most practical way of presenting free hydrogen to a mixture of phosphate and salt seemed to be to decompose steam by means of red-hot coke, while the combustion of the coke would serve to raise the temperature to the necessary degree, the coke thus serving a double purpose. Coke was used in preference to coal, that the escaping hydrochloric acid gas might be kept clear for afterwards precipitating the alumina.

A mixture in the proper proportions of phosphate, salt, and coke was now prepared, ground and mixed together in edge runners, moistened, laid out in thin cakes, and dried. The cakes were then stacked in a small cylindrical furnace of 3 feet internal diameter and 6 feet high, lined with 9in. brickwork, and enough coke added to serve as fuel, and fired. When the mass got red-hot a current of steam and air was forced through. After repeated trials good results were obtained, and it was found that on an average, 90% of the phosphoric acid in the "Redonda" was converted into tri-sodium phosphate. The re-actions are expressed by the equation—

$$AlPO_4 + 2(FePO_4) + 12(NaCl) + 6(H_2O) + SiO_2 + xC + xO$$
$$= Na_3AlO_3 + 3(Na_3PO_4) + 12(HCl) + Fe_2O_3 + SiO_2 + xCO.$$

On lixiviation the tri-sodium phosphate and sodium aluminate are dissolved out from the "ash," and the tri-sodium phosphate separated from sodium aluminate by crystallising as before described. The mother-liquor, consisting of sodium aluminate, is decomposed by the hydrochloric acid gas, precipitating alumina and reproducing sodium chloride. This decomposition is effected in condensing towers, in the same way as previously described. The alumina hydrate is then filtered and washed, the sodium chloride evaporated for use in a fresh furnacing. With the use of sodium chloride the production of calcium phosphate is much simplified, for calcium chloride can now be used to decompose the sodium phosphate. To produce tri-calcium phosphate, the crystals of tri-sodium phosphate are re-dissolved and calcium chloride added so that three equivalents of calcium are present for each equivalent of phosphoric acid. To produce di-calcium phosphate the dissolved tri-sodium phosphate crystals are first treated with sufficient hydrochloric acid to take up one equivalent of soda, producing di-sodium hydrogen-phosphate and chloride of sodium, and the mixture then has calcium chloride added in the proportion of two equivalents of calcium to one of phosphoric acid, producing a semi-crystalline di-calcium phosphate, which is filtered and washed in the ordinary way. This precipitated di-calcium phosphate is of very high strength, containing about 95% of di-calcium phosphate, or about 50% of phosphoric acid, equal to 109% tri-calcium phosphate.

It may be remarked here that calcined "Redonda" phosphate is freely soluble in ammonium citrate, and when applied, thus calcined and finely ground, as a fertiliser to the soil has been found of great efficiency, especially with roots and grass.

This method could be indirectly applied to the recovery of the phosphoric acid in the "basic slags" of the Thomas Gilchrist process. The slags could not be furnaced directly with sodium chloride in an atmosphere of hydrogen, or with sodium sulphate and carbon, for the sodium phosphate thus formed could not be extracted from the "ash" by lixiviation, as the caustic lime present in the ash would decompose it, precipitating calcium phosphate in the vats, along with the oxides of iron and manganese. By the methods of Messrs. Gilchrist Thomas and Twynam, however, the slag is dissolved in hydrochloric acid and a large proportion of the phosphoric acid precipitated from the solution as ferric phosphate; and this ferric phosphate is then decomposed by strong sulphuric acid, forming a mixture of free phosphoric and sulphuric acids and sulphate of iron, which is insoluble in excess of strong sulphuric acid, and can be separated by filtration. It appears to me that it would be more economical to recover the phosphoric acid of this ferric phosphate, in the form of *tri-sodium phosphate*, by furnacing with salt in the presence of hydrogen, and decomposing the tri-sodium phosphate by calcium chloride, precipitating calcium phosphate and recovering sodium chloride for use in future furnacings.

Manchester Section.

Chairman: Sir H. E. Roscoe.
Vice-Chairman: D. B. Hewitt.
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Peter Hart.	Watson Smith.
J. von Hohenhausen.	Wm. Thomson.
T. Jackson.	D. Watson.

Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, February 24, 1885.

SIR HENRY ROSCOE IN THE CHAIR.

The Chairman: Before beginning the usual business of the meeting, I wish to state that an international committee has been formed for the purpose of erecting a statue to the memory of Nicolas Leblanc, the well-known discoverer of the Leblanc process of alkali making. A large number of Continental scientific men and chemical manufacturers has been appointed a committee for the purpose of endeavouring to obtain subscriptions, with the addition of Colonel Gamble, Mr. Weldon and myself, as representing this country. I feel sure that every member of this Society is so well acquainted with the claims of Nicolas Leblanc, and with the enormous value of his discovery to English industries, that I believe you will all agree with me in thinking that it would be only proper for this Section

in particular, situated in the midst of a district which has profited so largely by this discovery, to send our acknowledgments to the committee, and assist them in helping forward the movement. I shall be glad to receive any subscriptions to the fund, and beg to commence the list with a contribution of five guineas.

THE HISTORY OF CREOSOTE, CEDRIRET AND PITTACAL.

BY PROFESSOR C. SCHORLEMMER, F.R.S.

Creosote was discovered by Reichenbach* in the year 1832; he found it in the tar, as well as in the pyroligneous acid obtained by the dry distillation of beechwood, and describes it as a colourless liquid, which strongly refracts light, and begins to boil at 203°. It has an unpleasant, penetrating smell, reminding one at the same time of that of smoked meat, and possesses the characteristic property of coagulating albumin. Meat, after being dipped in an aqueous solution of creosote for half an hour or one hour, may be dried in the open warm air of a summer's day without undergoing putrefaction. He showed samples of meat thus prepared at the meeting of the German Naturalists in Vienna, and people who had made many voyages found it very tasty.

Reichenbach continues: "Now, as pyroligneous acid by itself produces this effect, as well as the tar-water—which, according to public statements, may be prepared by lixiviating the soot of our stoves and chimneys—there cannot be any doubt that creosote is the *antiseptic, conservative principle* contained in these liquids as well as in smoke. As we further know from Pliny's tales that the Egyptians prepared their mummies with pyroligneous acid, which they obtained by carbonising the aromatic woods of their hot climate, we perceive that the ultimate cause dwells in the new body, creosote being the mummifying element. The so-called costly spices used by the ancients at the same time, were probably nothing but an expedient to mask with other perfumes the unpleasant empyreumatic smell dwelling in all the products of carbonisation."

Of the word *creosote*, which he proposed as the name for the new substance, he says: "I derive it from its property to preserve meat, being the most striking, the most peculiar, and that which has been known from the most ancient times. *κρέας* means in Greek flesh, the genitive being *κρέατος*, or *κρέαως*, and contracted *κρέως*; *σώζω* means, I preserve or save; both words may etymologically be combined to the word *creosote*, meaning the meat preserving or saving from decay.

Very soon after, Runge† discovered carbolic acid in coal-tar, and Laurence‡ obtained from it his hydrate of phenyl, which later on was found to be identical with Runge's compound. But as to the relation existing between creosote and carbolic acid no clea r views were held, and a confusion arose, which was kept up with an obstinacy unparalleled in the history of our science, and lasting for many years.

Runge described carbolic acid as an oily, very refractive liquid, which, like creosote, produces a white spot on the skin, after which it becomes glistening and peels off. Like creosote, it precipitates albumin and protects organic bodies from putrefaction, but it does not appear to be identical with smoky principle, inasmuch as meat preserved by it has an abominable taste. It differs, further, from creosote by being an acid and forming salts.

In spite of this, Reichenbach thought to recognise his creosote in carbolic acid; he was the more inclined to do so as he had previously stated that creosote was also found in coal-tar, animal-tar and amber-tar, almost as abundantly as in wood-tar.§

Runge could not agree to that; he maintained the peculiarity of carbolic acid, and described the properties by which the two bodies differed as exactly and correctly as it was possible at that time.‖

Laurent mentions in his well-known Memoir the great resemblance of phenylhydrate with carbolic acid and creosote, and says: "It is even probable that Runge's carbolic acid is nothing but impure phenylhydrate." Creosote, however, was regarded by him as a totally different body, on account of its higher boiling point, its inability to crystallise, even at 27°, while phenylhydrate forms crystals melting at 34° to 35°, and carbolic acid when cooled down deposits sometimes needles melting above 15°. Chlorine converts creosote into a brown substance, containing no chlorophenisic acid (trichlorophenol), which is readily obtained from phenylhydrate. Moreover, the action of bromine, nitric acid and ferric chloride on the latter compound is quite different from that on creosote.

These distinct statements did not prevent Gmelin to refer in his hand-book to Laurent's investigation, in order to prove his preconceived opinion that creosote, carbolic acid and phenylhydrate were identical, and differing only by a certain degree of purity.

Gmelin's views were accepted by most chemists, the more readily as Reichenbach himself believed in the identity of creosote and carbolic acid, and stated that he had obtained the former from coal-tar.

Soon carbolic acid was found in commerce under the name of creosote; the few chemists who were in possession of the genuine article could easily convince themselves of the peculiarity of creosote, but this was not sufficient to produce a change in the general accepted view. If about 40 years ago a chemist ordered creosote from a German firm he always obtained carbolic acid.¶

About that time, Gorup-Besanez examined a sample of "crystallised creosote," and compared it with one from Blansko in Moravia, where Reichenbach had discovered it. He found both bodies totally different, but he had not sufficient material for a more exhaustive investigation.**

A few years after he obtained again genuine creosote from Blankso through Batka in Prague, and found that it did not give picric acid by the action of nitric acid, and chlorine did not convert it into chlorophenisic acid, which can so easily be obtained from carbolic acid. On treating creosote with hydrochloric acid and potassium chlorate, no chloranil $C_6Cl_4O_2$ was formed, but a similar body containing *hydrogen*.††

Hardly any attention was paid to these observations; Gmelin mentions them in his hand-book, only to add that if Gorup-Besanez wanted to prove the existence of creosote, he ought to have examined that which he had prepared himself, and not a sample obtained from a wholesale druggist.

Two years later, Gorup-Besanez published a more extended investigation, in which he confirmed the statements of Reichenbach, Runge and Laurent. The portion boiling at 203·5 to 208° had the same composition as the creosote sent by Reichenbach to Liebig, and which Ettling had analysed. By the action of chlorine he obtained bodies, which he called

* Schweigger's Neues Jahrbuch Chem. Phys. 6, 301, 351; 7, 1, 57; 8, 57, 399.
† Pogg. Ann. 31, 69. ‡ Ann. Chim. Phys. (3), 30, 195.
§ Pogg. Ann. 31, 197. ‖ *Ibid*, 32, 306 and 328.
¶ Mohr, Comment. Deutsch. Pharm. 1863, 115.
** Ann. Chem. Pharm. 113, 152. †† *Ibid*. 75, 231.

chlorinated xylones, and formulated as *pentachlorxylone*, $C_{13}H_7Cl_5O_3$, and *hexchlorxylone*, $C_{13}H_6Cl_6O_3$. He pointed out that they bore great resemblance to Städeler's chlorinated quinones.*

Although this research did not clear up the chemical nature of creosote, yet it furnished a complete proof of the fundamental difference between creosote and carbolic acid.

At the same time Völkel published a paper on the same subject; he examined creosote which was manufactured from wood-tar in Solothurn. He purified it by repeated treatment with boiling potash solution, precipitation by sulphuric acid and subsequent distillation. The oily liquid thus obtained boiled at 202° to 208°, and exhibited the general properties of Reichenbach's compound: differing from it, however, by its higher specific gravity and its composition,† as the following results of the analyses of Ettling, Gorup-Besanez and Völkel show:—

	Creosote from Blansko (mean of 8 analyses).	Creosote from Solothurn (mean of 3 analyses).
Carbon	75·21	72·15
Hydrogen	7·90	7·10
Oxygen	16·89	20·15
	100·00	100·00

Völkel's creosote was therefore decidedly different from Reichenbach's, and his results, instead of contributing to the solution of the creosote question, made it more complicated, the more so as Deville, who analysed creosote which he had obtained from Reichenbach, and such which Pelletier had prepared, had got results agreeing with those of Völkel.‡

Völkel was of opinion that Gorup-Besanez's creosote had not been sufficiently purified, wherefore the latter subjected 500 grammes to the treatment, which Völkel had employed until only a few grammes were left. The amount of carbon had now diminished 1·5, and that of hydrogen only 0·2 per cent.

The smell of the purified product resembled that of guaiacol, which is obtained by the distillation of guaiacum resin. Gorup-Besanez says that the resemblance of guaiacol with creosote had already been noticed, and it appeared to him probable that from the latter by repeated treatment with potash guaiacol might be obtained.§

In the same year (1855) Williamson published the results of experiments which Fairlie had made, in order to find whether coal-tar creosote consisted of carbolic acid.‖ He thus discovered cresyl hydrate C_7H_8O, the next higher homologue of phenyl hydrate. This new compound, boiling at 203°, or almost at the same temperature as beechwood creosote, although not being mistaken for the latter, yet made the subject still more confused.

A new chapter in the history of creosote begins with Hlasiwetz's researches, "On Beechwood-tar Creosote and the Products of the Distillation of Guaiacum Resin."¶

By the action of potash on creosote from Blansko he obtained a crystalline potassium compound $C_8H_9KO_2 + 2H_2O$, which when decomposed by sulphuric acid yields a colourless, oily liquid ($C_8H_{10}O_2$), having an aromatic smell, a burning taste, and boiling at 219°.

The same body, which he called *creosote-guaiacol* or *creosol*, was found in the products obtained by distilling guaiacum resin, together with its lower homologue *guaiacol* $C_7H_8O_2$, which boils at 200°, and which had already been obtained by Deville and Pelletier.

* Ann. Chem. Pharm. 86, 223. † *Ibid.* 86, 66 and 93.
‡ Gerhardt, Traité. Chim. Org. 3, 20.
§ Ann. Chem. Pharm. 96, 39. ‖ Journ. Chem. Soc. 7, 232.
¶ Ann. Chem. Pharm. 106, 339.

Hlasiwetz was led to the conclusion that wood-tar creosote is decidedly not impure phenyl-hydrate, as Gmelin assumed; it is also totally different from coal-tar creosote, consisting chiefly of cresyl alcohol. Most probably it is a kind of ether corresponding to the potassium compound, and containing the radical C_9H_{11}, which would simply explain why creosote contains a larger percentage of carbon than creosol.

In the following year Duclos published a paper on cresyl alcohol, which he had obtained from coal-tar, but also found in the tar of the Giessen Gasworks, where only wood, chiefly pinewood, was used.**

This is, as Gorup-Besanez pointed out, in contradiction to all we know of the products formed by the distillation of wood. Neither he nor other chemists had succeeded in detecting phenols in wood-tar. If Duclos found such bodies we must come to the conclusion that pinewood yields products totally different from those obtained from beechwood.

Meanwhile Gerhardt†† had recalculated the formulæ of the chlorinated xylones in $C_8H_5Cl_3O_2$ and $C_8H_4Cl_4O_2$, regarding them as the homologues of the chlorinated quinones. Hlasiwetz's results gave a support to the new formulæ, and Gorup-Besanez intended to commence a new investigation, but was prevented, inasmuch as he could not get a new supply of creosote from Blansko; this source was exhausted, and different samples which he obtained from other sources under the name of beechwood creosote were found to be nothing but carbolic acid.

In 1864, Hugo Müller brought an important contribution to the history of our subject. He examined English creosote, which was prepared in London from *Stockholm-tar*, and appeared, as he wrote to Gorup-Besanez, to be identical with that from Blansko. He isolated from it Hlasiwetz's creosol, which by the action of iodine, phosphorus, and water, or hydriodic acid, was resolved into *methyl iodide* and *homopyrocatechin* $C_7H_8O_2$, the higher homologue of pyrocatechin $C_6H_6O_2$,‡‡

$$C_8H_{10}O_2 + HI = C_7H_8O_2 + CH_3I.$$

The investigations of Völkel, Gorup-Besanez, Hlasiwetz, and Müller, who had examined wood-tar creosote from three different sources, furnished the most convincing proofs that it has nothing in common with coal-tar creosote. In the way of a general agreement, there remained only the statement of Reichenbach that coal-tar contained creosote, and that of Duclos that wood-tar contained phenols.

Reichenbach, however, never proved his statement and as Duclos was the only chemist who found phenols in wood-tar, the great creosote question appeared now to be settled, and yet it did not come to rest.

In 1865, A. E. Hofmann examined different commercial products which he had obtained from several firms as genuine beechwood creosote. He obtained from them phenyl hydrate, and from this he prepared chloranil ($C_6Cl_4O_2$) and picric acid. Not being acquainted with the researches of Hlasiwetz and Müller, he denied the existence of an individual creosote, it being nothing else but impure phenyl-hydrate, while the chlorinated xylones consisted of a mixture of chloranil (tetrachlorquinone) and chlorinated phenols. The names creosote and hexchlorxylone had to be removed from the list of chemical compounds, while it might be convenient to retain the name creosote for the commercial article.§§

Gorup-Besanez replied that Hofmann, in order to prove his statements, ought first to have convinced himself that he had really to do with genuine creo-

** Ann. Chem. Pharm. 109, 135.
†† Traité Chim. Org. 3, 23. ‡‡ Chem. News, 10, 269.
§§ Journ. Prakt. Chem. 96, 225.

sote. Without difficulty he might have found that the druggists whom he mentions could not, though with best intentions, have supplied him with beechwood creosote, as it had disappeared from the German market long ago. Thus he would have not come into the position to prove, what was already known for a long time—viz., that carbolic acid was sold under the name of creosote.*

This episode had, however, an issue as unexpected as pleasing, for Fresenius informed Gorup-Besanez that the "Verein für Chemische Industrie in Mainz" manufactured creosote from beechwood-tar, and brought it into commerce. In examining it, Gorup-Besanez found that it was different from Blansko creosote, but probably identical with that examined by Völkel, inasmuch as the chief portion boiled at 199-207°. He succeeded in isolating from it a large quantity of *guaiacol* and some *creosol*. By acting on the crude creosote with hydrochloric acid and potassium chlorate, he obtained *tetrachloroguaiacone* ($C_7H_2Cl_4O_2$) and *tetrachlorocreosone* ($C_8H_4Cl_4O_2$), the latter being identical with hexchloroxylone. These compounds behaved like homologues of tetrachloroquinone, and might therefore be regarded as derivatives of the two yet unknown homologues of quinone, *guaiacone* and *creosone*, standing in the same relation to guaiacol and creosol as quinone to hydroquinone:

Quinone	$C_6H_4O_2$	Hydroquinone	$C_6H_6O_2$
Guaiacone	$C_7H_6O_2$	Guaiacol	$C_7H_8O_2$
Creosone	$C_8H_8O_2$	Creosol	$C_8H_{10}O_2$

On treating the crude Rhenish creosote with iodine, phosphorus and water, Gorup-Besanez obtained methyl-iodide and pyrocatechin, which undoubtedly were derived from guaiacol:

$$C_7H_8O_2 + HI = C_6H_6O_2 + CH_3I.$$

The latter bearing such a great resemblance to pyrocatechin, it appeared that it and creosol were the true homologues of pyrocatechin and not of hydroquinone. There was, however, one fact in opposition to this view—viz., pyrocatechin boiling at 240°, or higher than its homologues.

Gorup-Besanez found, further, that the yield of pyrocatechin and methyl iodide falls short of that indicated by the above equation, a large quantity of a thick oil, containing phosphorus, being found, possessing such an abominable smell, that he hesitated to examine it more closely, its odour adhering to the clothes most obstinately, that it made one socially impossible.

As already stated, Hlasiwetz assumed the existence of the compound $C_8H_9(C_9H_{11})O_2$ in Moravian creosote; Gorup-Besanez found that the composition of the Rhenish creosote agreed best with the assumption it contained the radical C_3H_5.†

This view was opposed by Marasse,‡ because if the portion of the creosote boiling between 199-208° contained this radical, it ought by the action of potash to yield allyl alcohol or a similar compound. But such a body had not been observed. Moreover, guaiacol being undoubtedly the methyl-ether of a kind of phenol, and it being known that such bodies are not decomposed by potash, Gorup-Besanez's view can be the less maintained as he purified creosote by repeated treatment with potash and hydrochloric acid, without altering essentially its composition.

But why does the percentage composition of Rhenish creosote differ so considerably from that of guaiacol or creosol?

	Creosote.	Guaiacol.	Creosol.
Carbon	72·14	67·74	69·58
Hydrogen	7·16	6·45	7·24
Oxygen	20·70	25·81	23·18
	100·00	100·00	100·00

The most simple answer is furnished by the assumption that creosote contains, besides guaiacol and creosol, some compounds containing more carbon and less oxygen, but boiling at the same temperature as these two bodies.

Marasse was able to prove this hypothesis; he found that the portion of creosote boiling below 199° contained common phenol or phenyl hydrate C_6H_6O, and the higher boiling portion its homologues cresol C_7H_8O, or cresyl hydrate and phlorol- or phloryl-hydrate $C_8H_{10}O$, together with guacol and creosote, which are the creonomethyl ethers of pyrocatechin and homopyrocatechin, which is proved not only by their decomposition with hydriodic acid, but also by the fact that they can be obtained from the latter simply by heating them with potash and methyl iodide.

As the initial members of both series have different boiling points, that of the first member of the guaiacol-gruppe agreeing with the second of the phenol group, it becomes self-evident that the most volatile portion of creosote must consist only of common phenol:

Phenol Series.		Boil. Point.	Guaiacol Series.		Boil. Point.
Phenol	$C_6H_5{\cdot}OH$	184°			
Cresol	$C_6H_4\left\{\begin{matrix}CH_3\\OH\end{matrix}\right\}$	203	Guaiacol	$C_6H_4\left\{\begin{matrix}OH\\OCH_3\end{matrix}\right\}$	200°
Phlorol	$C_6H_3\left\{\begin{matrix}(CH_3)_2\\OH\end{matrix}\right\}$	220	Creosol	$C_6H_3(CH_3)\left\{\begin{matrix}OH\\OCH_3\end{matrix}\right\}$	219

The creosote analysed by Gorup-Besanez was a mixture of guaiacol and creosol; one consisting of equal parts having a composition nearly agreeing with that found by him:

Carbon	72·41
Hydrogen	6·90
Oxygen	20·69
	100·00

Moravian creosote contains a larger percentage of carbon, being essentially a mixture of creosol and phlorol.

Marasse further proved that tetrachloroguaiacone and tetrachlorocreosone are not derivatives of guaiacol and creosote, but stand to cresol and phlorol in the same relation as chloranil or tetrachloroquinone to phenol. We call them now tetrachlorotoluquinone and tetrachloroxyloquinone or tetrachlorophlorone.

The Rhenish creosote was also examined by Bränninger; he found in his sample only traces of phenol, less than two per cent. of cresol, and no phlorol whatever. In the sample which Gorup-Besanez had examined he also found but little cresol, and still less phlorol§, whilst Mendelsohn and Tiemann‖ observed a large quantity of the latter compound in the portion of Rhenish creosote boiling at 220°. Another sample which Gorup-Besanez obtained, was examined by Biechle, who found it to consist almost entirely of creosol.¶

Creosote is, therefore, a mixture of guaiacol and creosol in varying proportions, with larger or smaller quantities of phenols. The presence of the latter shows that beechwood creosote is more closely related to coal-tar creosote than it was formerly believed. Characteristic of the former is the presence of the guaiacols, which do not occur in coal-tar, and which are undoubtedly produced by some aromatic bodies found only in wood, and which have been examined by several chemists.**

* Journ. Prakt. Chem. 07, 63.
† Ann. Chem. Pharm. 113, 129. ‡ *Ibid.* 152, 59.

§ Ann. Chem. Pharm. 185, 339.
‖ Ber. Deutsch. Chem. Ges. 10, 59.
¶ Ann. Chem. Pharm. 151, 104.
** Meissner and Sheppard, Unters. Eustehung. Hippurs. Hannover, 1867; Erdmann, Ann. Chem. Pharm. Suppl. 5, 223; Beute, Ber. Deutsch. Chem. Ges. 8, 476; Singer, Monatsh. Chem. 3, 395; Bevan and Cross, Chem. News 12, 47, and 91; 14, 61; Journ. Chem. Soc., 1883, 1, 18.

Creosote contains, besides phenols and guaiacols, some bodies which are insoluble in alkalis. Mendelsohn and Tiemann* found *homopyrocatechin-dimethylether*, or *methylcreosol*, $C_6H_3(CH_3)(OCH_3)_2$, which boils at 214-218°, whilst, according to Hofmann†, the higher boiling portion contains the following compounds, which dissolve in alkalis :

Pyrogallol-dimethylether.........$C_6H_3(OCH_3)_2OH$
Methylpyrogallol-dimethylether ..$C_6H_2(CH_3)(OCH_3)_2OH$
Propylpyrogallol-dimethylether ..$C_6H_2(C_3H_7)(OCH_3)_2OH$

These researches cleared up the chemical nature of two interesting compounds, which were also discovered by Reichenbach.

Cedriret does not exist, ready formed, in wood-tar, but is obtained from it, according to Reichenbach, by the following process : The rectified oil, which is obtained by distilling the tar, is freed from acetic acid by means of carbonate of potash, and then treated with a solution of caustic potash. The alkaline solution is saturated with acetic acid, by which some oil separates out, while another portion is obtained by distilling the aqueous solution. When about one-third has passed over, that which follows is tested with a solution of ferric sulphate. As soon as this produces a red precipitate—the distillate is collected separately. All bodies which easily part with oxygen produce this red colouration ; as, for instance, a solution of chromate potash and tartaric acid ; on adding it a red precipitate, consisting of needles, appears after five minutes, and soon fills the whole liquid, from which it slowly deposits, leaving a colourless solution. The same change is produced by the oxygen of the air.

This body is cedriret, which name is composed of *cedrium*, tar-water, and *rete*, net, because its crystals group themselves on the filter like a net.‡

According to Reichenbach, it is insoluble in water, spirits of wine, and all ethers, but dissolves in pure sulphuric acid, containing no nitric with an indigo blue—and in creosote with a purple colour.

Alcohol separates it from the latter solution in the form of a crystalline precipitate.

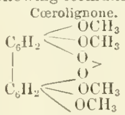
Berzelius says that it is only obtained in a small quantity ; and its preparation requires that skill in the treatment of empyreumatic bodies in which its discoverer has so often proved his mastership.

Völkel did not succeed in obtaining it from the wood-tar which he examined.§

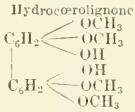
In the year 1872, Liebermann ‖ examined a blue substance, which he called *cœrolignone* $C_{16}H_{16}O_6$, and which obtained by purifying pyroligneous acid by means of potassium bichromate. ‖ He found it to be insoluble in most solvents ; sulphuric acid dissolved it with a cornflower-blue colour and phenol with a red colour. Alcohol or ether precipitate it from the latter solution in beautiful steel-blue needles. Reducing agents convert it into colourless *hydrocœrolignone* $C_{16}H_{18}O_6$, crystallising in monoclinic prisms. On heating the latter with hydrochloric acid to 200°, it is resolved into methyl chloride and *hexhydroxydiphenyl* $C_{12}H_4(OH)_6$, which, by red-hot zinc dust, is reduced to diphenyl $C_{12}H_{10}$.

These facts prove that hydrocœrolignone is the tetramethyl-ether of hexhydroxydiphenyl, and cœrolignone the corresponding quinone. Liebermann gives the following formulæ :—

Cœrolignone.



Hydrocœrolignone.



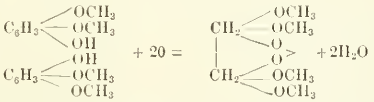
* Ber. Deutsch. Chem. Ges. 8, 1136; Tiemann and Koppe, *Ibid.* 14, 2005.
† *Ibid.* 7, 78; 8, 66; 11, 329 and 1455; 12, 1371 and 2216.
‡ Berzelius, Jahresb. 15, 408.
§ Ann. Chem. Pharm. 86, 102.
‖ *Ibid.* 169, 221,

Marx,¶ and afterwards Hofmann,** pointed out that Liebermann's compound was nothing else but Reichenbach's cedriret. Hofmann obtained it by the action of potassium chromate or nitric acid on a high boiling oil from wood-tar, in needles having a violet lustre, and says Reichenbach had described it, not only with a precision which leaves nothing to wish for, but also so attractively, that one must be astonished how a body possessing such charming properties had been neglected for thirty years—nay, almost entirely forgotten.††

Liebermann recognised the identity of cedriret with cœrolignone, to which he had given this name on account of its blue colour, of its being obtained from wood, and possessing the characteristic properties of a quinone. He says that as Reichenbach had described it as a red body obtained from a high boiling oil, from which neither Völkel nor he were able to prepare it, while cœrolignone had a blue or violet colour, and was derived from pyroligneous acid, he had formerly come to the conclusion that cedriret, if existing, would probably be nearly allied to, but not identical with, cœrolignone.‡‡

Hofmann, who prefers Reichenbach's shorter and very characteristic name, found afterwards that cedriret is a derivative of the dimethyl-ether of pyrogallol. On adding potassium bichromate to its solution in acetic acid, the liquid becomes hot, and some is filled with needles, which, in transmitted light, appear red, and in the reflected splendidly steel-blue. It may also conveniently be prepared by adding hydrochloric acid to a boiling alkaline solution of potassium chromate and pyrogallol-dimethylether, the liquid changing into a mass of slender reddish-brown needles.§§

Its formation is explained as follows :—



Pittacal.—Reichenbach observed that the oil from wood-tar, which is heavier than water, after being freed from acids by caustic potash, yields, when stirred up with baryta water or baryta hydrate, a blue colour, which gradually changes into black. The new body thus formed he called pittacal (ῄπεττα το καλλον), but gives no particulars as to its mode of purification, etc., reserving it for a further communication. He describes it in the following words : "When obtained from a solution as a precipitate or separated by evaporation, it unites to a hard, brittle, dark-blue mass, having a dull fracture ; like indigo, it assumes a metallic reflection on rubbing, which varies from a coppery lustre to a pure brass-yellow, according to its purity, being in the mean a splendid golden yellow, in striking contrast to the dark blue ground. This golden lustre appears also on allowing the moist mass to dry up. When pure, this lustre predominates in such a way that it cannot be obtained without it ; everything moistened by it—porcelain, glass, paper, linen, etc.—appears gilded on a blue ground.

"In the pure state it is taken up by water ; on standing, the dilute solution deposits dark violet flakes, and becomes colourless ; but if concentrated nothing separates out. It dissolves freely in acetic acid, with an auroral colour ; alkalis throw it down again. On pouring an aqueous solution into concentrated potash-lye, the bright blue colour changes into a violet blue,

¶ Wagner's Jahresb. 1872, 827.
** Ber. Deutsch. Chem. Ges. 8, 66.
†† *Ibid.* 7, 78.
‡‡ *Ibid.* 8, 96.
§§ Ber. Deutsch. Chem. Ges. 11, 329.

and after some time blue flakes separate, consisting of fine needles.

"It combines with metallic oxides, and gives with sugar of lead, tin-salt, sulphate of copper ammonia, acetate of alumina, blue precipitates having a violet lustre."

Reichenbach adds: "It thus appears to have a technical value, which for Europe, where no indigo is produced, may become of an incalculable importance. Preliminary experiments have shown that it may be fixed on cotton or linen by means of acetate of alumina or tin-salt, producing a fast blue, not being affected by light, water, soap, ammonia, urine or wine."*

Reichenbach did not publish any more on this subject; nor did Völkel succeed in preparing it,† and it was almost forgotten, till Grätzel, a chemical manufacturer in Hannover, re-discovered it. On oxidising the high-boiling fraction of wood-tar oil he obtained a colouring matter, which he gave to Wichelhaus for further examination.‡

On purifying the crude product a compound was obtained crystallising from alcohol or dilute acetic acid in orange needles, dissolving in ammonia with a blue, and in the alkalis with a purple colour. On allowing the solution to remain in contact with air, or more quickly on passing carbonic acid into it, blue salts are precipitated, which also occurs on the addition of salt-solutions. They are soluble in pure water. If the precipitation proceeds slowly a skin is first formed on the surface, exhibiting a splendid metallic lustre. The salts of calcium, barium, magnesium, and tin give blue precipitates, often showing a golden reflection; those produced by calcium and magnesium being soluble in pure water.

The compound dissolves in concentrated sulphuric acid with a purple colour, changing by heat into a bright, pure blue.

The orange crystals are not Reichenbach's pittacal; the latter consisting of the salts of this body, which Wichelhaus, in order to avoid mistake, and in remembrance of Reichenbach's body, called *eupitton* (εὐ, beautiful).

Hofmann § then found that this compound, which he calls *eupittonic acid*, $C_{25}H_{26}O_9$, is obtained by heating the dimethyl-ether of pyrogallol with hexchlorethane and alcoholic potash to 160° to 170°:—

$$3C_6H_3(OCH_3)_2OH + C_2Cl_6 + 7KOH = C_{19}H_8(OCH_3)_6O_3 + CHKO_2 + 6KCl + 5H_2O.$$

It is also produced by melting a mixture of the dimethyl-ethers of pyrogallol and methylpyrogallol with caustic soda in the presence of air ‖:—

$$2C_6H_3(OCH_3)_2OH + C_7H_5(OCH_3)_2OH + 2NaOH + 3O = C_{19}H_6Na_2(OCH_3)_6O_3 + 5H_2O$$

Reichenbach obtained from the oils of wood-tar a liquid, which he called *picamar (pice amarum)*. It boiled at 285°; had a faint but unpleasant smell, and a bitter, burning taste, which afterwards becomes cooling like that of peppermint. Its alcoholic solution gave with baryta-water pittacal, and from this it appears that his picamar contained the dimethyl-ethers mentioned above.

Eupittonic acid contains two atoms of hydrogen, which can be replaced by metals. On adding caustic soda to its alcoholic orange solution it changes into splendid blue colour, a flocculent precipitate of *sodium eupittonate* $C_{19}H_6O(OCH_3)(ONa)_2$ separating out, which after 24 hours is converted into a mass of small prisms having a beetle-green lustre. *Barium eupittonate* $C_{19}H_6O(OCH_3)_6O_2Ba$ is a precipitate consisting of blue needles, while the lead-salt crystallises in pale reddish needles.

At the same time when Reichenbach carried out his researches at Blansko, Runge in Berlin examined the constituents of coal-tar, in which he discovered carbolic acid, as already mentioned. On treating coal-tar oil with milk of lime, and allowing the solution to remain in contact with air, it coloured red, a compound being formed which he called rosolic acid.¶ It is easily seen that the formation of this body is quite analogous to that of pittacal. But the constitution of these two compounds is also perfectly analogous, rosolic acid or *aurin*, as it is now called, being obtained by heating carbolic acid with oxalic and sulphuric acids:—

$$3C_6H_6O + C_2H_2O_4 = C_{19}H_{14}O_3 + CH_2O_2 + 2H_2O.$$

Now eupittonic acid is *hexmethoxylaurin*—

$$C_{19}H_8(OCH_3)_6O_3,$$

which is proved by its formation as well as by its properties. On heating aurin with ammonia, it is converted into pararosaniline:— **

$$C_{19}H_{14}O_3 + 3NH_3 = C_{19}H_{17}N_3 + 2HO.$$

In the same way Hofmann converted eupittonic acid into *hexmethoxylpararosaniline*—

$$C_{19}H_{11}(OCH_3)_6N_3,$$

which dyes silk, sulphurated wool, and tannated cotton a fine and pure blue.

I have already stated that the guaiacols, as well as the other methyl-ethers contained in wood-tar, owe their origin to certain aromatic compounds contained in wood. Although we know but little of them, we have got a clue to their formation. The cambial liquid of the coniferæ, from which in spring and early summer the new wood is formed, contains the glucoside *coniferin* $C_{16}H_{22}O_8$, which, as Haarmann and Tiemann†† have shown, is by the action emulsin, a ferment contained in almonds, resolved into grape sugar and coniferyl alcohol:—

$$C_6H_3 \left\{ \begin{matrix} C_6H_4.OH \\ OCH_3 \\ OC_6H_{11}O_5 \end{matrix} \right. + H_2O = C_6H_3 \left\{ \begin{matrix} C_3H_4.OH \\ OCH_3 \\ OH \end{matrix} \right. + C_6H_{12}O_6$$

Coniferyl alcohol, as well as coniferin, are converted by oxidation into *vanillin*††, which gives to vanilla its delightful smell.

The same compound may, as Reimers and Tiemann found, be obtained from wood-tar, it being formed by heating guaiacol with chloroform and caustic potash‡‡:—

$$C_6H_4 \left\{ \begin{matrix} OCH_3 \\ OH \end{matrix} \right. + CHCl_3 + 3KOH = C_6H_3 \left\{ \begin{matrix} OCH \\ OCH_3 \\ OH \end{matrix} \right. + 3KCl + 2H_2O.$$

By a similar reaction Reimers has converted phenol in salicylaldehyde, a constituent of the aromatic oil of the meadow-sweet *(Spiræa Ulmaria)*.

I may further mention that Griffiths has found phenol in the stem leaves and cones of the Scotch fir *(Pinus sylvestris)*.§§

Pelletier and Walter, in the introduction to their Memoir on the chemical investigation of the products formed in the preparation of illuminating gas from resin, say that chemical operations which are carried on a large scale permit the observation of certain phenomena, and the investigation of certain laws, as well as the discovery of new products, which by

* Schweigg. Neu. Jahrb. Chem. Phys. 8, 1.
† Ann. Chem. Pharm. 86, 103.
‡ Ber. Deutsch. Chem. Ges., 9, 334; Gratzel, *Ibid.* 11, 2085.
§ *Ibid.* 11, 1115.
‖ Ber. Deutsch. Chem. Ges, 12, 1371 and 2216.

¶ Pogg. Ann. 31, 70.
** Dale and Schorlemmer, Journ. Chem. Soc., 1877, 2, 121.
†† Ber. Deutsch. Chem. Ges. 8, 609.
‡‡ *Ibid.* 9, 123.
§§ Chem. News, 49, 95.

working in the laboratory would have escaped our notice. Chemical industry, which, in its advance, uses theories as scouts, thus pays back its debt to the chemists who have given assistance in furnishing them with new compounds for their examination, and thus extending the sphere of our science.

Thus the manufacture of coal-gas has made chemists acquainted with some new bodies of the greatest interest. Without gas lighting we should probably have yet to discover Faraday's liquid hydrocarbons (butylene and benzene), Kidd's naphthalene, and Dumas and Laurent's para-naphthalene (anthracene).

It is scarcely necessary for me to enumerate here how many new and important bodies have since been obtained from coal-tar. This black, fœtid substance, formerly a large, embarrassing bye product, has now become of the highest importance for the production of most splendid colours. Hand-in-hand with the development of this new chemical industry went scientific researches, which, without the use of coal-gas, could never have been undertaken. For the chemistry of the aromatic compounds coal-tar has become an, as yet, inexhausted source for new bodies, and for the artificial preparation of such as hitherto found only in the organic world.

But also the investigation of wood tar has largely contributed to the development of organic chemistry, as shown by the short historic sketch which I have laid before you.

What a revolution, not only in chemical industry, but also in dyeing, calico-printing, and even in agriculture, the discovery of coal-tar colours has wrought, I need not dwell upon here.

Hofmann said in his reports on the Exhibition of 1862, speaking of these new colours, that England may ere long send her coal-derived blues to indigo-growing India, her tar-distilled crimsons to cochineal-producing Mexico, and her fossil substitutes for quercitron and safflower to China and Japan.

This prediction has not been quite fulfilled; but stranger events have happened. Who would then have thought that in less than twenty years the cultivation of madder would almost be a thing of the past? A few years ago a friend of mine, an eminent chemist, whose name I have mentioned to-day, was travelling in the South of France: after having seen all the sights of old Avignon, he requested his guide to take him to the madder plantations, but was told they did not grow any more. On being asked why, he replied, "Monsieur, it is now all made by machinery."

The cultivators of cochineal might almost say the same; the beautiful colour contained in it has not yet been obtained artificially, but substitutes have been found which have supplanted cochineal almost completely.

Coal-tar is not only a source of a host of most splendid colours, but also of valuable medicines—substitutes for quinine,—and the time is not far distant when quinine itself and other alkaloids will be prepared from tar. When on the Continent last year I visited one of the largest chemical works, where some new buildings were in course of erection. Asking my friend what they were for, he replied, "These are our future quinine works." What then was said as a joke may soon be said in earnest.

DISCUSSION ON THE "RIVERS POLLUTION BILL."

Sir Henry Roscoe said: As you are aware, the Council of our Society has requested the various sections to consider and discuss "The Prevention of Pollution of Rivers Bill," which has been prepared and brought into the House of Commons by Mr. Hastings, Earl Percy and Colonel Walrond, in November last, and which either in its present form or in an amended form may be brought before Parliament this session. Of the importance and at the same time the difficulty of legislating on this question, you are fully aware, and the differences of opinion which have been already expressed by various members of this Society, serve to show the obstacles which have to be overcome before the question can be satisfactorily solved. Before asking any of the members or strangers present to favour us with their views on this question, I may perhaps be allowed to state shortly the outcome of the opinions which have been so far expressed by various members of the Society in other sections.

[The Chairman then rehearsed the leading arguments of the principal speakers in the meetings of the other Sections where the subject had already been discussed. He then proceeded]:—

These abstracts give an idea of the various opinions entertained on this subject, so far as the discussion has already progressed. Of the advisability or necessity for some regular enactments there seems to be a general concensus of opinion. It also appears to be shown and felt that the application of a uniform standard to rivers throughout the country is inexpedient in the interests of the manufacturing industries of the country. Opinion is, however, much divided as to whether standards of purity of any kind should be adopted or not, and the difficulty of arriving at standards for every river, or rather for every part of every river, is too evident to need discussion. Nor is it necessary to enlarge on the essential difference between a rigid application of standards of purity in the case of the Alkali Acts, when every manufacturer is supplied with an unlimited quantity of the pure article—viz., air—and the application of similar unvarying standards to the case of water, which is supplied neither in quantity nor in quality to any manufacturers alike. The only course which then appears to be left open is to treat each case in its own merits, or to establish certain broader limits, which may be applicable to all cases. The proposal that county boards should take charge of, and have control over, the running water, whether pure or impure, in its district, appears to me to be the one most likely to lead to satisfactory results; each would be well acquainted with the necessities and possibilities of its particular county, and would apply under proper scientific advice, and with due control from a central authority as the Local Government Board, such regulations as are possible and suitable.

Alderman Walmsley, Chairman of the Rivers Conservancy of the Salford Corporation, said: I have come here to listen rather than to speak, because I want a great deal of help and guidance, and I thought I might elicit something from the discussion which would be of service to me in connection with the Borough of Salford. I have listened with a great deal of interest to the details of the Bill, as described by the Chairman, and to the results of the discussions of the various sections of your Society, and I must say that the outcome to my mind is one of almost hopeless confusion. Men of eminence in the scientific world seemed to vie with each other in contradiction, so that comparatively unscientific men, like myself, are at a loss how to deal with the practical difficulties which have to be contended with. I was very much struck with the remark of one gentleman to the effect that he would do away with all standards of purity, and require manufacturers to return the water to the streams in the same condition as they receive it. If that rule were carried out by all manufacturers up to

the source of the river, they would have pure rivers so far as regards manufactories. Public authorities, in dealing with this question, had to consider two aspects of it. Firstly, they had to take care that nothing was done that would be calculated to interfere with the commercial interests too much; and, secondly, they had to consider the health of the community, and look at it in a similar manner as they did with regard to the smoke nuisance. I think anyone who has tried to deal practically with the difficulty of sewage pollution must feel very disheartened. I have at the present time an investigation going on as to the state of the Irwell from Manchester up to its source, and when I first began that investigation, I had some hope that the matter might be grappled with, but I find that the difficulty is greater and more serious than I had anticipated; still the Salford Corporation was determined to try to cope with it. With regard to the proposed Bill, it seems to me that we must not be too precise and anxious to carry out our own ideas. If we must have an Act that will be workable, it must be based on a give-and-take policy.

Dr. Hewitt: When we have to deal with rivers which have been for half a century or so the natural receptacle for the drainage of populous districts engaged in commerce, we come to a problem of great importance. If the owners of works so situated are to be deprived by legislation of the use of these natural outlets for the refuse of their manufactories, they are at least entitled to have some other outlet provided for them. No serious attempt had been made to put in operation the "Rivers Pollution Act" of 1876; that individuals had been made to suffer it was true, while others had escaped, and my belief is that it is premature to bring in another Bill for the purpose before that Act has been fairly tried. I believe that no good can be done until local influences are removed and some statesmanlike action taken for dealing with the question evenly and equally all over the kingdom. For my purpose I would prefer that the matter should be placed in the hands of officials sent down from London by the Local Government Board, because my experience of them has been that they are fairly free from prejudices; that they are always ready to hear both sides, and are exceedingly impartial. If it were left to such officials to decide what is practicable, I believe we might in a few years arrive at some satisfactory standard. For my own part I do not think that the evidence is sufficiently clear at present to furnish any definite standard. My idea is that a system of general inspection of rivers should be insisted upon, and that some such power should be given to the Local Government Board as was given to them under the Alkali Acts, in reference to noxious vapours, whereby they could require every manufacturer to adopt the best possible means of preventing the pollution of a stream. After all there can be no doubt that the greatest difficulty we have to contend with is the pollution by sewage, and I believe it is this difficulty alone that has led to so little being done to enforce the present Act. I very much admire the courageous, costly, and persistent efforts which the Salford Corporation have made to deal with their sewage. I understand that the cost incurred by the Salford Corporation is not far short of £200,000, and that their working expenses are very large. This is a very serious expense, even when dealing with the sewage of a town like Manchester; but how many towns are there which could afford such an outlay? But when all this outlay has been incurred, according to the last Report of the Commissioners on Rivers Pollution there is no known method of dealing with sewage so that the effluent from it is fit to drink, and that being so it seems to me a most cruel attempt on the part of Mr. Hastings to fix standards of purity, quite beyond any one's power to realise, for his standard of colour has been shown to be infringed by bog and peaty water. I for one would agree to any practicable standard that would put manufacturers upon one basis. If you place one manufacturer under certain restrictions which increase his working expenses, and allow another manufacturer in the same business to carry on his work in his own way, you would very likely ruin one while you assisted the other. We should have an Act of Parliament that would be entirely independent of local influences, because the present Act is often put in force against manufacturers by men who are the greatest offenders themselves. What is needed is more knowledge, a central authority to carry out the law, and that the pollution of sewage should be dealt with first. The manufacturer should have the right to turn his effluent water either into the channel he has used for years, in as pure a condition as it is possible at reasonable expense to obtain, or, at least, if this be taken from him, he should have the right to use the sewers for which he is rated, provided that he does not injure the sewers or otherwise damage his neighbours.

Mr. Arthur Jacob, Engineer to the Salford Corporation, said that he had looked carefully through the draft Bill, and was familiar with the provisions of the Rivers Pollution Act of 1876. It is the duty of the Salford Corporation, as the conservators of the River Irwell within their borough, to exercise a jealous supervision over the river from its source to the point where the stream passes the borough boundary. The existing Act did not, however, prove to be very workable in respect of offences committed outside the borough, for if any pollution were cast into the stream above, it was almost impossible to secure the conviction of the offender, unless the polluting matter could be actually detected in that part of the stream which passes through Salford. In consequence of this imperfection in the old Act, the river had continued to silt up, and was now in almost as bad a state as it was ten years ago. He thought it was high time that some amendment was effected in the law for preventing river pollution. No community felt this necessity more keenly than those whose avocations obliged them to remain in the vicinity of that Stygian stream, the Irwell, the state of which was a disgrace to all who suffered its condition to continue as it is at present. Dr. Hewitt had told the meeting that Salford stood forth as an honourable exception, and as an example to other sanitary authorities on the stream. The Corporation had spent more than £200,000 on sewerage works to prevent the pollution of the stream; and he (Mr. Jacob) believed that the Corporation of Bolton were also carrying out works of such a magnitude as would deal with all the sewage of that borough. It is not to be wondered at that the Irwell and Mersey are in their present foul condition, when it is recollected that besides the polluted discharges from some hundreds of manufactories, the rivers receive the whole of the refuse from a population of one-and-a-half million of people. In the existing Act it was not made at all clear what was included under the term pollution, and this made it very difficult to bring offenders to justice; but the draft Bill is much more explicit in this respect, and in other respects is an improvement on the existing law, though it will have to be amended before it can be called a thoroughly practical measure. It is too Utopian in its character, and is calculated to press somewhat heavily on the manufacturing industries; and, moreover, its language is in some parts vague and involved, instead of being plain to all, and devoid of ambiguity. With regard to the standards set forth in the proposed Bill, the discussion of them

would be more for the chemist than the civil engineer. As particularised, the standards were not (as was before remarked), standards of purity, but limits of maximum impurity. Taking standard *a*, which provides that not more than one part of organic matter and three of mineral matter shall be found in 100,000 parts of water. This would prevent sanitary authorities from carrying out what is known as the duplicate system of drainage, by which all surface waters from streets, houses, courts, and yards are allowed to pass into the natural water-courses of the country. Compliance with this would involve a very burdensome restriction upon sanitary authorities, as the duplicate system usually led to considerable reduction of expense, and particularly in cases where the sewage has to be raised by steam power at the outfall. Professor Way has said "that so far as London sewage is concerned, and considering only the composition of the liquid which reaches the sewers in time of rain from the streets, it seems pretty certain that it would be as valuable in a manurial point of view as the ordinary contents of the sewers." Standard *b* does not appear to be too stringent where sewage can be treated by irrigation or downward filtration. It provides that not more than 2 parts of organic carbon, or ·3 part of organic nitrogen, shall be present in 100,000 parts of any liquid passing into a river. At Croydon, a year's analysis of the effluent water from the Norwood irrigation fields gave an average pollution of 1·515 of organic carbon, and 0·258 of organic nitrogen. This was from a pure clay soil, whilst at the Beddington farm the results were almost as good. He (the speaker) believed that these analyses had been made some years ago, and he understood that the purification was as effectual now as formerly. It seems impossible that the colour test, standard *c*, can ever be fully complied with. Rain-water passing from the surface of roads, and even from agricultural land, always retained a certain amount of colour, and not unfrequently carried a large body of grit and soil in suspension. It will be exceedingly difficult for owners of dye-works to comply with this standard, though no doubt they can effect a great improvement in the colour and quality of the water which they now send from their works.

Mr. Heywood said : With regard to the standards of purity alluded to in the Bill, I should like for one moment to refer to the case of the firm I represent—viz., Messrs. Dickins & Co., of Middleton. We turn down the river Irk close upon a million gallons of refuse water per day, and at certain times it is, as Mr. Jacob said with regard to the Irwell in Manchester, as "black as ink" in consequence of our using such quantities of dyewood extracts, especialy logwood, along with the various metallic salts, etc., and in addition to these, there is of course a host of commercial drugs and chemicals as well as the different aniline dyes. What plan could we possibly adopt to purify such a volume of water so as to conform to the requirements of the Act, especially Clause 9? If such a case were put before the framers of the Bill, would it not convince them at once that no dyeworks or printworks of any magnitude could possibly exist under such restrictions?

Mr. Wm. Thomson : The series of standards of pollution mentioned in the proposed Act applied indiscriminately to rivers would doubtless make highly polluted ones comparatively clear, but it would also furnish a basis for polluting pure ones. For rivers which are at present used for domestic water supplies, the standards of pollution allowed by the proposed Act are too high ; whilst for highly polluted rivers, the main advantage which would be gained would be to make the streams less discoloured. The Irwell, which I have closely examined on different occasions, and which may be taken as a typically polluted stream, is dark coloured, due mainly to solid sewage matter in suspension, which settles at parts of the river where there is little current, such as behind weirs and bends of the stream in which the water is comparatively still ; usually there is no disagreeable smell from the river, but at some points of the stream in dry and warm weather objectionable smells arise. Still on settling this water, it can be used for many delicate manufacturing processes, and it would be usually much less costly for manufacturers to settle or filter the water they require to be clear from the river than to settle their refuse waters. It may be taken as certain on the one hand that it will cost the people of Lancashire immense sums of money to keep the Irwell a little less coloured than it is at present, and the advantage gained by so doing will be little or nothing. Dr. Hewitt considered that streams in which fish live should be kept pure, because they are sources of food supplies, and I agree with him ; but on the other hand to purify some streams would absorb from, instead of yielding food supply to the people, and it will give them no adequate advantage for the expenditure. I think each river is of sufficient importance to be separately dealt with, and whilst it would be advisable that some restrictions should be enforced to preserve the purity as far as possible of all streams, such restrictions should be arranged and drawn up by the people who are more or less interested in each stream.

Mr. Watson Smith : I have arranged my ideas, for the sake of brevity, under the following subdivisions :—

I. *(a)* Some waters, streams and rivers, must be polluted according to the very nature of the industries —*e.g.*, bleaching, dyeing, printing and the like ; and in some dyeing processes, as, *e.g.*, silk preparing, bleaching and dyeing, it is absolutely necessary that water-streams as pure as possible, and that even an atmosphere as pure as possible, shall be available.

(b) In a less degree is river pollution a necessity in other industries.

(c) Hence to prevent pollution entirely, would mean destruction of some industries and the maiming of others.

(d) The fixing of impracticable standards of impurity, is tantamount to destruction of these industries—*e.g.*, the colour standard of the proposed Bill would be very hard on dyers, and it must be remembered many of their colours have enormous tinctorial power, which means that an infinitesimal weight of dye would be represented by a distinct colour.

II. The nature of the pollutions will vary in different districts, will depend upon the prevailing industries in these districts. Thus, the Tyne will contain HCl, $CaCl_2$, alkaline and earthy sulphides, finely divided sulphur, gypsum, etc., whilst the notorious Bradford-Beck will contain colouring-matters, and dyes, fatty matters, suds, oils, besides the solutions of the various mordanting materials, etc.

III. Hence fixed standards would be unjust, and indeed absurd, for we could imagine an alkali maker having a solitary works on the banks of one river, lined with cotton mills and weaving mills, polluting wholesale, whereas a whole district of alkali works on a river like the Tyne might be laid under legislation of prohibitory stringency.

IV. There are cases, where one can conceive *pollution* voluntarily abolished, being transformed into *utilisation*, but these cases are exceptional Such transformation can usually only slowly take place.

V. To draw the line by *enforcing utilisation*, must be done intelligently and by those who know at least

as much as the manufacturers about their products, and who have scientific light enough to see ahead. Even then the scheme of enforcement should be at the first, at all events, of a not too stringent or sweeping character. Then, *enforcement* would be transformed into *co-operation*—as, witness the *Alkali Act* for greatly limiting the amount of hydrochloric acid thrown into the atmosphere.

VI. To *limit* pollution and keep it within certain bounds, differing for the various districts, is possible. The limits will ever grow narrower as scientific knowledge increases, and becomes more general.

VII. No pollution of water should be allowed which communicates pollution to the air in any way, or such that the water thus contaminated will act corrosively and destructively upon materials in the river or river-bed or banks, such as brickwork, cement, mortar, stonework, woodwork and the metals lead, copper and iron.

VIII. Water-courses of every kind running into and supplying reservoirs or lakes from which drinking water is drawn, or springs serving for drinking water, ought to be strictly preserved from contamination.

IX. It ought to be remembered that sewage contamination is the most virulent form in existence, outstripping in deleterious action by far that of the factories. If all the works on the banks of the rivers Irwell and Medlock were stopped, yet their waters would still remain badly poisoned by sewage, and so be made not one whit more potable than before.

X. I agree with Mr. Coleman of the Glasgow Section, in thinking the "standards of purity" which are proposed in the Bill to be brought before Parliament, for universal application, would be utterly impracticable. But, says Mr. Coleman, there is nothing to prevent standards being established for different parts of the country, by grouping the local authorities appointed under the Bill into districts.

XI. Hence I quite think the plan supported by Sir Henry Roscoe would be best and most likely to be successful—viz., to appoint county boards, for the prevention and mitigation of river pollution, aided by scientific experts, with whom they shall consult. A standard could then be framed for each district in each county, and just and fair legislation could then be enacted, and all pollutions either prevented, mitigated, or kept within due bounds, according to the varying local circumstances. No doubt it would follow that the Local Government Board would be the centre, where the proceedings of the Provincial Local Boards would be focussed, so to say, for purposes of general reports and for legislative government action.

Dr. Hewitt moved the following resolution :—"That the Prevention of the Pollution of Rivers Bill as proposed and brought into the House of Commons by Mr. Hastings is imperfectly drawn and Utopian in character, and could not in its present shape be carried into operation without serious injury to the manufacturing and commercial community ; and the Manchester Section hereby requests the Council of the Society to oppose the Bill in its present form."

Mr. E. T. Cunliffe, in seconding the resolution, whilst fully agreeing with the terms of it, said : I am of opinion in regard to our discussing this subject, that we must guard ourselves from appearing too obstructive towards any progress that may be attempted in the direction of the proposed Bill. If we take the old Act and see what it has effected, I think we are bound to admit it has done a great deal by preventing the putting into the streams of any solids. There has been no difficulty in carrying out this part of the Act, and the streams have been greatly improved by it. There can be no doubt that before any Bill can be carried out, it must be less Utopian in character than the one proposed. To frame a Bill dealing with the purification of streams beyond the exclusion of solids is too great a step at once, and I am of opinion that such standards of purity only in the first instance must be fixed which experience has shown to be practicable, and that future legislation must be progressive. I would distinguish between sewage pollution and manufacturing pollution, the central authority should deal with the former as a matter pertaining to the public health ; the latter might at some future date be dealt with by county boards, who might group the polluters and appoint a commission to investigate and report as to the best means of dealing with the subject.

The resolution was then put to the meeting and carried unanimously.

HEMPEL'S METHODS OF GAS ANALYSIS.

BY DR. W. BOTT,

The Owens College, Manchester.

It is only a comparatively short time ago that gas analysis has at all been introduced into the rank and file of the *methods of technical analysis*, but in the short space of time since then and to-day it has gained a firm and important position amongst them, and in its application to several branches of industry has become as valuable and indispensable as any of our ordinary gravimetric or volumetric processes. The great end in view of all technical methods of analysis is rapidity ; at the same time this must be combined with a sufficient degree of accuracy, and a great number of processes for technical gas analysis have been devised, more or less pretending to one or both of the above requirements. The principles of all these methods, we must bear in mind, had been established once for all by the founder of systematic gas analysis, Robert Bunsen, whose methods, as far as extreme accuracy and ingenious simplicity are concerned, stand unequalled above all others. Unfortunately, however, they are scarcely applicable to technical purposes, requiring, on the one hand, a great expenditure of time, and, on the other, a considerable degree of manipulative skill, which can only be acquired by long practice and experience. Still, the majority of technical methods that have been devised, and are being devised almost every day, are but modifications of the classical methods laid down by Bunsen.

The chemical principles involved in gas analysis are only few, simple, and common to *all* methods ; the difference between such methods—that is to say, the advantage of one method over another—consequently cannot be due to the employment of new re-agents, but must be sought for in the mode of applying these re-agents, and mode of measurement of the gas, or, in short, in the form of the apparatus devised for the purpose. We shall have to give the preference to such an apparatus as will admit—

1. Of an easy collection and accurate measurement of the sample.

2. Of an easy application of the respective re-agents and accurate measurements subsequently.

3. Of repeated of the same quantity of re-agent for same length of time.

Among the numerous methods proposed and apparatus constructed for technical gas analysis, those of Walther Hempel claim precedence as being accurate, rapid, and almost universally applicable. By way of qualifying this assertion, I may say that Hempel's apparatus has the following advantages :—

1. It admits of the use of all sorts of solid or liquid re-agents, including such absorbing agents as fuming

H_2SO_4, HNO_3, bromine, etc., which destroy India-rubber joints, or attack the grease used for lubricating glass stopcocks.

2. It allows of a complete exhaustion or utilisation of the re-agents, including such re-agents as pyrogallol, Cu_2Cl_2, etc., which are spoiled by contact with air.

3. It greatly obviates the errors due to the mechanical absorption of gas by the absorbing agents, and finally, it can be used for the analysis of mixtures of N, H, and CH_4, giving results which are sufficiently accurate for technical purposes.

I will now, after these few introductory remarks, endeavour to describe the various parts of Hempel's apparatus, and explain their respective uses.

First of all, we have the apparatus used for the collection and measurement of the sample of gas to be tested. This consists of a couple of gas burettes A and B (see Fig. 1), communicating with one another by an India-rubber tube. One of the burettes—the one in which the gas is collected and measured—terminates in a short capillary tube, fitted with a short piece of India-rubber tubing which can be closed by means of a pinchcock *d*. The burette B is divided into 100cc. Now, if we want to collect and measure a certain sample of gas, we proceed as follows: Both burettes A and B are completely filled with water, care being taken that all the air contained in the India-rubber tube connecting the burettes is displaced, which may readily be done by raising A, B being closed at the time, and shaking the apparatus, when any bubbles of air retained in the India-rubber tube will ascend and escape through A. As soon as the apparatus is properly filled with water, *d* is closed by means of a pinchcock, and the greater part of the water in A poured out, the connection between the two burettes being shut off by pressing the india-rubber tube while this is being done, so as to prevent any air getting into B. We now connect B by means of a suitable tube with the apparatus from which the gas is to be drawn; open *d*, and, by lowering A, syphon the gas into the measuring tube. As soon as a sufficient quantity has been collected, *d* is closed, and the apparatus allowed to stand for a minute, so as to allow the water to flow down from the sides of the tube. We then equalise the pressure in A and B by raising or else lowering A, as the case may be, till the columns of water in both tubes are exactly on a level, and then read off. It is convenient to measure out exactly 100cc. of gas, the results obtained by subsequent absorption, etc., then at once represent the percentage. In order to obviate the error due to the mechanical absorption of gases by water, it is well to employ water previously saturated with the gas to be tested. All the measurements, it is almost needless to say, must, of course, be made at temperatures as nearly constant as possible. If we are dealing with a gas containing considerable quantities of constituents, which are decomposed by, or else very

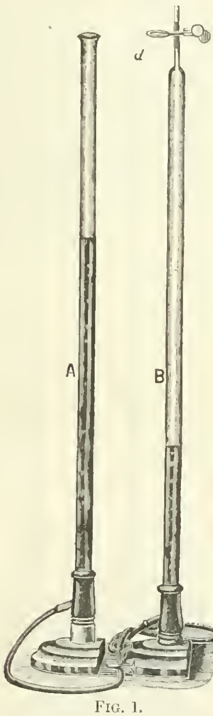


Fig. 1.

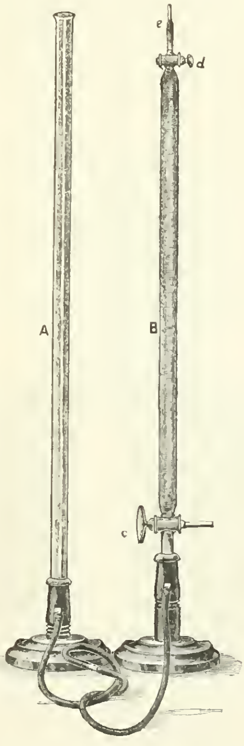


Fig. 2.

soluble in, water, the above method cannot, of course, be used. In such a case we may use another form of burette, very similar to the gas burette originally designed by Winkler (Fig. 2). It differs from the simple gas burette only by the measuring tube B being fitted with two glass stopcocks *c* and *d*: the stopcock *c* is a three-way cock, by means of which the measuring tube B can be shut off from, or set in, communication with the second tube A, or else the air outside, or a pump. The collection and measurement of samples by means of this burette is done in the following manner: The measuring tube B is thoroughly dried by drawing a current of dry air through it, communication with A being shut off by means of the three-way cock. By means of a suitable tube attached to *e*, and connected with the apparatus or space from which the gas is to be taken, the gas is drawn through the measuring tube (this is easily done by a small pump or aspirator attached to the three-way cock *c*) till all the air has been displaced by the gas, when *c* and *d* are turned, so as to shut off the gas in B from the air outside, as well as from communication with A. Water is then poured into A, and by turning *c* can be gradually admitted into B, so as to absorb the soluble constituents. When the absorption is completed, the residual volume of gas is read off, the difference between this and the original volume (100cc., since B holds exactly 100cc. when full) directly giving the percentage of soluble gases.

So much for the modes of measurements by means of Hempel's gas burette, and we have next to consider the apparatus employed for the subsequent treatment of the sample—viz., the absorption of its respective constituents. Hempel used for this purpose two apparatus, which he terms the simple and the compound absorption pipette. The simple absorption pipette (Fig. 3) essentially consists of two glass bulbs *a* and *b*,

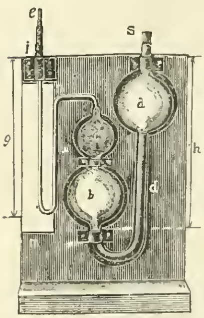


Fig. 3.

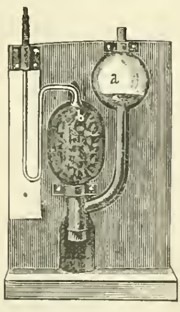


Fig. 4.

connected by means of the bent glass tube *d*. (*N.B.* The Fig. also contains a small third bulb *c*, which, however, is not strictly required; most of the simple absorption pipettes, in fact, only consist of the two bulbs *a* and *b*.) The lower bulb *b* is connected with a capillary U-tube *u*, fixed on a white porcelain plate *mm*; the whole apparatus is mounted on a suitable wooden stand. The absorbing agent is introduced into *b*, which must be completely filled with the solution, whilst the second bulb *a* remains nearly empty. A slight modification of the simple pipette is shown in Fig. 4. It is intended for the use of solid re-agents such as phosphorus, and merely differs from the ordinary burette just described, by that the second bulb *b* is made more of cylindrical shape, and has an opening at the bottom *k* communicating with an aperture *l* in the stand, through which the solid re-agent can be introduced. The apparatus shown in the Fig. represents such a pipette filled with a solution of KHO and containing plugs of wire gauze, so as to obtain a large active surface on displacing the KHO solution by the gas to be tested; it is used for the estimation of CO_2.

When an absorption has to be made by means of the simple absorption pipette, say with the KOH pipette represented in Fig. 5, the capillary U-tube is connected with the measuring burette containing the sample by means of a small capillary glass tube *f*, the pincock *d* opened, and by gradually raising A the gas is driven over from B into the bulb *b* of the pipette, where it displaces a portion of the absorbing fluid

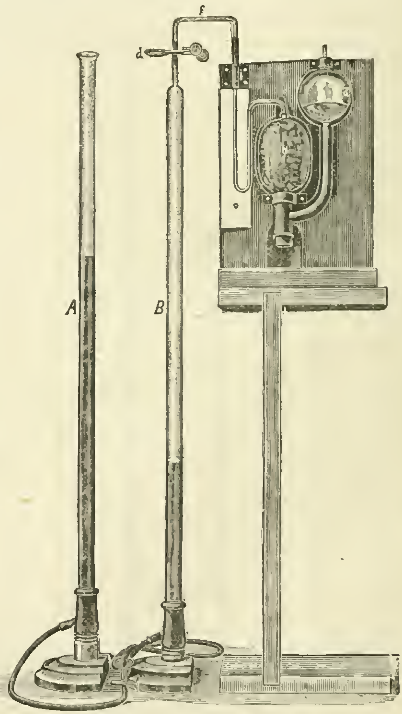


Fig. 5.

which rises into the empty bulb. As soon as all the gas has been transferred, the connection with B is shut off at *i* (by means of a pinchcock), and the absorption in the pipette hastened by shaking the gas with the re-agent. When the absorption is complete, the communication with B is restored, and by lowering A the gas is syphoned back into the tube B, the pinchcock *d* closed, and the volume measured in the manner already described.

The compound gas pipette (Fig. 6) is intended for the use of re-agents which are acted upon by atmospheric air; it may be regarded as a combination of two simple pipettes, and consists of four bulbs, *a*, *b*, *c*, *d*, communicating by glass tubes. The first of these

bulbs (a) is again completely filled with the re-agent, *f* inst., an alkaline solution of pyrogallic acid; the second (b) is empty; the third bulb (c) is filled with distilled water; and the fourth, again, is empty. When an absorption has to be made, bulb a is connected with the measuring burette in the manner already mentioned (see Fig. 5) and the gas passed in. The liquid displaced in a then rises into the second bulb b, and the air displaced in this is forced into the third bulb c, where it displaces an equal volume of the distilled water, which then rises into the fourth and last bulb d. Thus we see that the displaced absorbing agent in this pipette only comes into contact with the small quantity of air contained in b; now since the communication of b with the atmosphere is shut off by

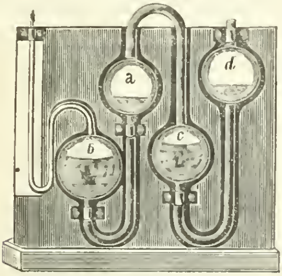


FIG. 6.

the water in the third bulb c, the action of the small quantity of air or oxygen in b upon the re-agent soon ceases; the oxygen is absorbed, and there remains a perfectly indifferent gas—viz., nitrogen. The compound gas pipette is used for the absorption of oxygen by alkaline pyrogallic acid solution or of CO, by an ammoniacal solution of Cu_2Cl_2 (cuprous chloride) re-agents, which must not, of course, be exposed to air—viz., oxygen.

The combustion or explosion of gases is also carried out by means of a gas pipette, which is represented in Fig. 7. The bulb b, in which the combustion is effected, is rather thicker in the glass than the bulb

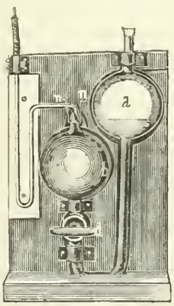


FIG. 7.

of the ordinary gas pipette, and has two platinum wires fused into the top nn, through which an electric spark can be passed. The communication with the second bulb a can be shut off at pleasure by means of a glass stopcock d. The first bulb b is completely filled with a dilute solution of KHO; a is empty. The gas to be exploded is introduced by means of the gas burette in the usual manner, the requisite quantity of air and hydrogen added, and after closing d and e, and mixing the gases thoroughly by skaking, the mixture is exploded by passing a spark through nn. On opening d some of the liquid rises in the bulb b proportionally to the contraction produced by the combustion. The residual gas is then syphoned back into the burette and measured. The air required for such an explosion is of course accurately measured, and introduced by means of the burette, and so is the hydrogen. The latter is generated in a separate simple gas pipette (Fig. 8) by means of pure zinc and dilute sulphuric acid. The zinc is used in the form of a hollow stick d, which is fixed on a glass rod r, passed through a cork, and is thus introduced into the bulb b of the pipette, which is then completely filled with dilute H_2SO_4. The evolution of hydrogen at once commences, and e being closed the hydrogen evolved in bulb b displaces the acid, forcing it up into bulb a, till it is no longer in contact with the zinc, when the evolution ceases. On opening e the hydrogen in b is driven out by the pressure of the acid in a, which again descends into the first bulb, where it

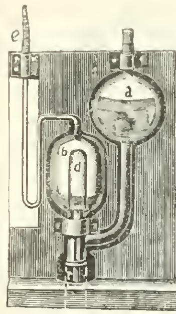


FIG. 8.

comes into contact with the zinc, and setting up a brisk evolution of hydrogen, but as soon as e is again closed, the acid is forced back into a, and the evolution stops. Thus we have in this hydrogen pipette a means of generating a continuous current of hydrogen, sufficiently pure for combustion or explosion. Regarding the chemical principles involved in the process of burning or exploding gases, and the various precautions to be observed, I must refer to the chapter in Bunsen's "Gasometry" (translated by H. E. Roscoe), as such a discussion is altogether beyond the scope of this sketch.

In order to illustrate the working of the whole apparatus, it will be well to consider the analysis of a mixture containing most or all of the gases likely to be met with in actual testing. Let us take a mixture of CO_2, O, CO, olefines (viz., C_2H_4, etc.), CH_4, H and N. A sample of this gas—say 100cb.m.—is collected and measured in the gas burette. We next absorb the CO_2 by passing the gas into an absorption pipette, containing a solution of 1 part of KHO in 2 parts of water (Fig. 4). To ensure a rapid and complete absorption the bulb b containing the caustic potash is partly filled with plugs of wire gauze, which on displacement of the potash solution by the gas offer a large surface moistened with the re-agent. The absorption of the CO_2 is almost instantaneous—all we have to do is to pass the gas into the apparatus and syphon it back

again to be measured. The contraction produced directly gives us the percentage of CO_2, since we started with 100cc. The remaining gas contains O, CO, H, C_2H_4, CH_4, N; we next absorb the oxygen. This may be effected in two ways—by means of moist phosphorus or by an alkaline solution of pyrogallic acid. The former method is by far the more elegant of the two, but not universally applicable. The absorption is done in an ordinary pipette (Fig. 9), the bulb (*b*) of which is filled with thin sticks of yellow phosphorus surrounded by water. The gas to be tested is introduced in the usual manner, and by displacing the water in *b* comes into contact with the moist surface of the phosphorus which speedily absorbs all the oxygen from it. The absorption proceeds best at about 15-20° C., and is complete in ten minutes. The small quantity of phosphorus acid formed by the absorption dissolves in the water present, and thus the surface of the phosphorus always remains bright and active. As has already been mentioned, this neat and accurate method is not universally applicable; the following are the conditions under which it can be used:—The percentage of oxygen in the gas must not be more than 50%, and the gas must be free from ammonia, C_2H_4 and other hydrocarbons, vapour of alcohol, ether and essential oils. In the instance we have chosen, the phosphorus method would hence not be applicable, as our mixture contains C_2H_4. We must therefore resort to the second method using pyrogallic acid. The absorption is carried out in the compound absorption pipette (Fig. 6), the bulb *b* of which is completely filled with an alkaline solution of pyrogallol made by dissolving 1 part (by volume) of a 25 per cent. pyrogallic acid solution in 6 parts of a 60 per cent. solution of caustic potash. The absorption is complete in about five minutes, but may be hastened by shaking. The remainder C_2H_4.CO, CH_4, H, N of our gas now contains N, and the next step is to absorb the C_2H_4, which is done by means of fuming, and determine the CH_4 by explosion. Let us choose the latter method and take a portion, say a-half, of our residual gas for the estimation of hydrogen. The absorption of the hydrogen is based on the fact that palladium in a finely divided state so-called palladium black—is capable of completely burning hydrogen when mixed with excess of air, and slowly passed over the metal at the ordinary temperature. About 1½grm. of palladium black are placed in a small U-tube (Fig. A) plunged into cold water, and the gas mixed with an excess of air (which of course must be accurately measured) is passed slowly through the tube two or three times, the tube at the time being connected with an ordinary absorption pipette filled with water or else with the KOH pipette, which in this case, of course, simply serves as a kind of receiver. Finally the gas is syphoned back into the burette and measured—two-thirds of the contraction correspond to the amount of H originally present in the mixture of gas and air. The CH_4 is not attacked by sulphuric acid (ordinary 30 per cent. SO_3 Nordhausen acid answers well enough). The acid is contained in an ordinary absorption pipette (Fig. 10), the small bulb *c* of which is filled with pieces of broken glass or glass wool, so as to offer a larger absorbing surface to the gas. The absorption is complete in a few minutes, but the remaining gas previous to measuring should be passed into the KOH pipette and back again, so as to free it from fumes of SO_3. Residual gas: CO, CH_4, H, N. The carbonic oxide is next absorbed by means of an ammoniacal solution of cuprous chloride in a compound absorption pipette. The gas has to be shaken with the absorbent for about three minutes. It must be borne in mind that Cu_2Cl_2 solution also absorbs oxygen, and, according to Hempel, considerable quantities of C_2H_4, hence these gases must be removed previously. Residue: CH_4, H, N. We may now either determine both CH_4 and H by exploding with an excess of air in the explosion pipette and measuring (1) the contraction produced, and (2) the amount of CO_2 formed (by means of the KOH pipette); or we may, according to Hempel, absorb the hydrogen first of all in this reaction—provided the U-tube be kept well cooled with water. At about 200° C, however, a mixture of air and CH_4 is also acted upon by palladium. The presence of CO, vapours of alcohol, benzene and hydrochloric acid interferes with the absorption by palladium.

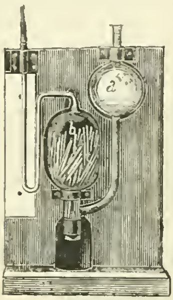


Fig. 9.

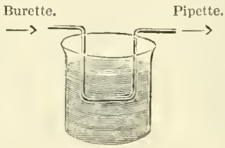


Fig. A.

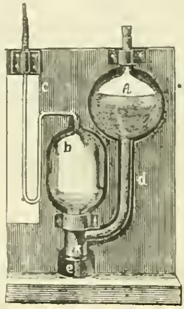


Fig. 10.

The palladium can be used for many consecutive experiments, but must be kept as dry as possible. After it has been used for several absorptions it may be regenerated by plunging the tube into hot water and passing a current of dry air through it.

Having estimated the hydrogen, we have lastly to determine the CH_4 in the remainder of our gas. This contains CH_4N and H, the amount of the latter being known from the previous experiment. The gas is mixed with the requisite quantity of air and hydrogen, introduced into the explosion pipette and fired by means of a spark. The water resulting from the combustion condenses in the bulb of the pipette, whilst the CO_2 formed is absorbed by the KOH solution present. Hence the total contraction produced corresponds to:

a. The hydrogen present in the original gas + ½ its vol. of O (the quantity requisite for comple combustion).

b. The known quantity of hydrogen added + ½ its vol. of O.

c. The CH_4 present + 2 vols. of O requisite for its combustion.

$$\underbrace{\underbrace{CH_4}_{2} + \underbrace{O_4}_{4}}_{6} = \underbrace{(CO_2+2H_2O)}_{\text{disappears.}}$$

Since a and b are known, or can be readily calculated from the previous data, we can by subtracting $(a+b)$ from the total contraction obtain $C-(a+b)=c$ contraction due to CH_4 alone, and one-third of this is equal to the volume of CH_4 present, as will be readily seen from the above equation.

The remaining nitrogen is estimated by difference, a direct method of determination not being known at the present time.

The above brief sketch will at all events suffice to show the value of Hempel's methods for technical purposes. A complete analysis of a complex mixture like the one chosen for the purpose of illustrating these methods need only occupy twenty to thirty minutes, so that a great number of such analyses may be carried out in a day. Moreover, with due care and skill, the results obtained are very accurate indeed; in fact, more accurate than is generally required or expected from a technical process.

DISCUSSION.

Dr. HEWITT: We are greatly indebted to Dr. Bott for his valuable paper. All I can say is, if we have not thoroughly grasped all he wished to convey in his demonstrations with the apparatus, he has nevertheless reduced a very complex system of testing gas to a very simple operation, and I certainly think that syphoning back must give a degree of accuracy which is not otherwise attainable. We know that there are many processes which require continual testing for their elucidation. It is not merely necessary to know what may be done in the course of 24 hours, but it is absolutely necessary to know what is going on from time to time. I am sure that Dr. Bott's method would be valuable in making the tests of gases in the working of Deacon's process for the manufacture of chlorine. Difficulties often arise in the analysis of mixed gases, and I should like to have had the opportunity of having the mixed gases in Deacon's process determined by some simple method like the one before us. I have no doubt, from what I have seen to-night, that possibly this apparatus might be of considerable assistance in facilitating the rapid determination of the carbonic acid and hydrochloric acid which abnormally are found in the gases passing to the bleaching powder chambers, and which, when present in any appreciable quantity, defeat the manufacture of good bleaching powder.

Dr. MARKEL: I have had some experience with the apparatus before us, and would therefore like to add, as regards its accuracy, that on comparing it with Bunsen's method I found the results obtained agreed within 0·1 to 0·3 per cent. for each gas. The gas analysed on this occasion contained CO_2, O, Co, H, CH_4, N. Besides showing this surprising degree of accuracy, Hempel's method is the most expeditious of any I know. I have made as many as fourteen analyses daily with it. Dr. Bott has remarked that it is necessary to allow the gas to stand for a few minutes in contact with the first reagent. I do not think it is necessary to let the gas remain longer in contact with the potash than is required to pass it into the pipette and back again into the burette, when the CO_2 is completely absorbed. The O is absorbed by the alkaline pyrogallol in two to three minutes. Phosphorus is preferable for absorbing the oxygen, but as the above-mentioned gas contained traces of ammonia, it could not be used. Co is also completely absorbed in the pipette fitted with ammoniacal cuprous chloride in two to three minutes, provided the pipette is well shaken. The palladium-black causes unition of the H and O, when the gas is allowed only to pass once over it and back again. It can be used for an indefinite number of times, provided the water which collects in the tube is removed from time to time by allowing warm air to pass over it. The whole operation ought not to exceed half an hour if everything is well prepared.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: J. Campbell Brown.

Committee:

Ernest V. Bibby.	C. Symes.
Hudson A. Binney.	G. I. J. Wells.
Eustace Carey.	F. Hurter.
John Hargreaves.	H. Brunner.
E. Milner.	A. Norman Tate.
E. W. Parnell.	J. Affleck.

Local Sec.: E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The next meeting of this Section will be held at University College, Ashton Street, April 1, 1885, when the following will be the order of proceedings:—(1) Election of Officers for Session 1885-86. (2) Discussion on Mr. Pratt's Paper, read March 4. (3) Paper on Electric Lighting, by Mr. Holmes.

UNIVERSITY COLLEGE, ASHTON STREET, LIVERPOOL, *Wednesday, March 4, 1885.*

MR. E. K. MUSPRATT IN THE CHAIR.

"THE RIVERS POLLUTION BILL."

BY E. K. MUSPRATT.

As one of the most useful functions of our Society is to take into consideration, and to criticise with the knowledge of experts, any proposed legislation of the character of the "Rivers Pollution Bill," I have at the request of the Committee prepared a paper on the subject.

I must, however, take this early opportunity of saying that I am by no means competent to deal in a comprehensive manner with this most difficult subject, and that I have undertaken the task solely with the view of raising a discussion on the Bill by members more competent than myself.

The growth of manufacturing industry, together with its manifest blessings and the consequent increase of the well-being of the people, is unfortunately accompanied by evils which it is our duty, and I hope our desire, to mitigate. The framers of this Bill, I am afraid, either from ignorance or with design, attempt by law absolutely to prevent them. From my reading of the Bill there is no clause similar to the clause in the Act of 1876, which exempted the manufacturer from the penalties of the Act, if he used the best practicable means for rendering harmless the polluting liquid which he sent into a stream. It follows, therefore, if this Bill becomes law, that unless he can purify the liquids flowing from his works, so as to satisfy the standards prescribed by the Bill, a manufacturer must absolutely close his works, and sacrifice all the capital invested therein. As all of you have read the proceedings of the London Section, in which Mr. Cresswell gave a very able exposition of the Bill, it will be unnecessary for me to attempt to call your attention at any length to the legal aspects of the question. Mr. Cresswell says the Act of 1876 was "a piece of lame and impotent legislation," and this Bill is brought in to remedy its defects. Now, the prime defect of that Act, he says, is the want

of machinery for carrying it into execution, and he points to the reluctance of the sanitary authorities (the greatest culprits themselves) to put the Act into execution, but admits that recourse may be had to the Local Government Board, to compel the sanitary authorities to put the Act in force.

He then complains of the delay caused by the visit of the inspector, who really has to determine upon the best practicable means to prevent the pollution. This, then, is the grievance, and this Act is intended to remove it, which it proposes to do very effectually by prohibiting the running of any polluting liquid into any stream or river, whether tidal or otherwise, irrespective of cost to the miner or manufacturer.

I think, however, the case against the Act of 1876 has not been made out. Mr. Cresswell says fifty-three proceedings have been taken under the Act, and *twenty-four orders* to restrain pollution have been obtained, but have never been enforced at all.

Now, why have these orders never been enforced? I applied to Mr. Cresswell for an explanation, and he wrote to me to say, "that it is not the duty of the Local Government Board to enforce them; on the contrary, they have in almost every case intervened to extend the period assigned for compliance with the order under Clause 3 of the Act of 1876, and that, *e.g.*, the order in the Hereford case, which was made in 1878, has been suspended in successive years until February, 1885." But by this Clause 3 the Local Government Board can only grant this extension of time if they are satisfied, after local inquiry, that further time ought to be granted to enable the sanitary authorities to adopt the best practicable and available means for rendering harmless the sewage matter complained of.

Now as Mr. Cresswell admits that in some cases the Act has been put in force, it seems to me that in this Hereford case it is probable no available means are at hand, although, as we are aware, there are several towns which, to a great extent, do render their sewage harmless, it seems strange that nothing has been found practicable—in this special case—for seven consecutive years.

In the case of manufacturing pollutions, the difficulty may be greater, and the cost to the individual manufacturer may be so great and so much out of proportion to the necessity of the case, that the Local Government Board would be fully justified in stopping proceedings on the ground that "some material injury will be inflicted by such proceedings in the interests of such industry."

But is it not possible, without altering the intention of the Act, to improve its machinery? We are all agreed that pollution of rivers should be prevented, provided the cost of such prevention is not too great, and if the present Act is as faulty as it is said to be, something should be done to amend it.

If we attempt to march too fast we may very easily frustrate the object we have in view, and it is desirable, in the first instance, to ascertain what is practicable in the way of prevention. We know how the Royal Commissioners, at the instigation of Dr. Frankland, decided that certain standards of purity were attainable, and these standards are practically adopted in the Bill we are considering.

It was a fatal error that on the Commission only theoretical chemistry was represented in the person of Dr. Frankland, for I need hardly remind members of our Society that something beyond a knowledge of scientific chemistry is required to decide what is practicable in chemical operations on a large scale. But even scientific chemists are by no means unanimous in favour of the standards recommended.

Mr. Crookes is of opinion they are on an entirely erroneous basis, and I think we must all agree with him that to lay down absolute standards of purity for every river was a mistake.

It certainly seems more reasonable that each river should be considered on its merits. The addition of certain substances which by themselves might pollute a pure stream, would be beneficial in the case of the Irwell or the Mersey, and until sewage matter is kept out of the Thames the addition of salts of iron, manganese, zinc, or bleaching liquor, for example, need not be prohibited. It is straining at a gnat and swallowing a camel if, before we have dealt effectually with the great sewage question, we press on chemical manufacturers enormous expense in order to improve the quality of the liquids escaping from their works.

If the germ theory of the origin of cholera and typhoid be true, it is far more important in a river like the Thames, which is a source of potable water, to prevent its pollution by sewage than by manufacturers' refuse, and yet, so far as I know, this has not yet been accomplished.

It is true Sir John Lawes seems of opinion that the sewage of London itself is of great benefit in increasing the catch of fish in the Channel, but the inhabitants of London ought not to be obliged to drink the sewage of the population above the intake of the water companies, and if pollution of this character can be prevented there would be no reason against enforcing the adoption of similar means of purification in towns on other streams. Whether the standards recommended by Dr. Frankland are attainable or not, some standard for sewage pollution might certainly be found after practical experience in dealing with the sewage on a large scale, and such standards might fairly be made more stringent as the methods of purification improved. What is really wanted is a practical method of dealing with sewage on a large scale, and the experience of the last ten years ought to be able to furnish us with one.

What might fairly be required of an inland town ought not to be required for a town on an estuary like the Mersey, and the same principle—*i.e.*, having regard to the general character of the river—should be applicable to pollution from manufacturing processes. I am therefore of opinion that Mr. Crookes is clearly on the right path in making the river or stream, and the uses to which it is to be applied, the standard of pollution, and not the liquid running into it.

The criticisms of the manufacturers when the standards of the Pollution of Rivers Commission were first published are in the main applicable to those in the present Bill.

[Mr. Muspratt here read extracts from the evidence of Mr. Stevenson and others before the Royal Commission.]

As regards solid matter, Mr. Newlands pointed out at the London meeting that the great bulk of the rivers of the kingdom contained more than the standard as suspended mud, and that the colour standard in subsection C was far too stringent, and really is of no use, for many natural rivers or streams are much more coloured.

Mr. Johnson complained in London that in some cases they were too stringent and in others too lax, particularly those referring to acidity and alkalinity, if they were permitted in any stream employed subsequently as a water supply.

In many cases these standards are absolutely impracticable, and Lord Salisbury, in introducing the Bill of 1875, admirably summed up the objections to them: "The difficulty that was felt with regard to these tests was that they struck too far, and that on the one hand they would include water flowing from perfectly innocent sources, while on the other hand they were not sufficiently stringent to affect the

very nuisances against which the legislation was directed."

After giving this Bill my best consideration, I have come to the conclusion that it is framed on an entirely wrong principle, inasmuch as it proposes the same standards of pollution irrespective of the locality and circumstances of the case.

If passed into law, it would have a most injurious effect on the industry of the country, as many works and mines could not possibly comply with its provisions. If the present Act cannot be enforced on account of the power given to the Local Government Board to supervise or restrain its application, the attempt to give this power to individuals, or even to induce individuals to complain of pollution by paying the penalties for the offence to them, as it is suggested in Clause 3, might be grossly abused for private purposes.

The power to set the Act in motion ought to rest with a public body, and if the sanitary authorities are interested parties, the new County Boards, which are sure to be established at an early date, seem to be the proper body for the conservancy of the rivers in their district, and the preservation of the rivers from pollution.

The attempt to fix standards of universal application is wrong in principle, but after some experience local standards on the lines of Mr. Crookes' suggestion—viz., that the river itself should be the standard of purity, and that no liquid should be allowed to be sent into a river if the liquid contains a greater percentage of impurity than the river itself—might possibly be adopted.

I have in the foregoing pointed out how injurious to manufacturing interests this Bill might become, if made law, but have not attempted to go into any minute details on the chemistry of the question, which I know will be ably handled by other members present.

Dr. Hurter has informed me of some investigations in Saxony which bear out the view I have taken, that until the sewage question is dealt with, the keeping-out of manufacturing refuse, except solid matter, which may interfere with the flow of a stream, is hardly necessary.

Metallic salts disappear from solution in a marvellous manner, and cannot be traced at even a short distance from the place where they flow into a stream. These same investigations will also support the view that regard must be had to the condition of the river itself, both as to its velocity and the volume of water; and I have no doubt the discussion this evening will throw further light upon many of the points I have so lightly touched upon.

The subject has now been discussed in most of our sections, and the result will be to give the Council of the Society ample information to guide them in any suggestions they may have to make to those in authority, on this Bill or any other that may be brought in to deal with this most important question.

DISCUSSION.

Dr. Hewitt thought it was clear upon the evidence before the Rivers Pollution Commission, that sewage pollution and trades pollution stood upon a totally different footing. The sanitary objection had arisen not from trades pollution, but from sewage pollution. He thought it would be a new feature in English law if simply for æsthetic reasons Parliament were to interfere with those industries by which England had gained her greatness. The greater evil undoubtedly was sewage pollution, and in many instances it interfered seriously with the health of towns. That this was a very difficult question no one would deny, especially when he heard the enormous cost to Salford of their sewage system. While the sanitary authorities are the chief sinners, they are constituted the authority to carry out the law and put pressure upon the manufacturers, but they had found practical difficulties in dealing with the question. The chairman of the Conservancy Committee in Salford acknowledged that the more he tackled the question the more the mountain of difficulty seemed to grow, and he found that it was not a question to be gone into lightly, or that very strict standards could be employed. Dr. Hewitt held that something should be done, but whatever was done, it should be carried out in a uniform manner. The only point upon which he (Dr. Hewitt) was inclined to differ from their Chairman was as to the estuaries. There was a great difference in estuaries, and some distinction should be made between one estuary and another. They must not introduce a system which would bear more hardly upon one manufacturer than another. They must not press upon the one higher up the river, and leave the one lower down to escape altogether. If so, this would introduce between men in the same trade a very objectionable want of uniformity. He would support almost any degree of strictness in a Noxious Vapours Bill, because it was required from all manufacturers in the same trade to conform to the same standard. It was abundantly clear that sewage effluents could never be fit for potable water, and, therefore, there was no need to seek for such a standard of purity from the manufacturer; it was idle to expect that the standards in this Bill could be realised, for natural sources of pollution would often make the river to infringe such standards. If they passed an Act of Parliament which could not be realised, there would be absolutely no results from it, whereas if they could pass an Act of Parliament which could be carried out by some conservancy board or county board, working under the Local Government Board, some good might be effected. If a river was an important source of food supply, then it was very important to take steps to prevent its serious pollution, but the case was different when the rivers were used for drainage and trade purposes alone. The Mersey and the Irwell had ceased entirely to be sources of food, and to insist upon the same standard in reference to these rivers, as for those other rivers to which he had referred, would, in his mind, be to inflict a lasting injury upon trade in which the interest of this country was so largely bound up. He therefore thought the Legislature would hesitate to pass such a Bill. It had been proposed that instead of sending the waste water from manufactories into the rivers it should be sent into the sewers. The men who owned large works were those who paid the large rates, and nobody had a better right to use the sewers than those who so largely paid for them, and if this user of the sewers caused any damage the manufacturer should be made liable for it. At the same time he admitted some little pressure should be brought to bear on the manufacturers, as they were quite ready to blame each other and do nothing. Any one reading the replies to the inquiries addressed by the Rivers Pollution Commissioners could see that each manufacturer was impressed with the value of good influx water, and was ready to apportion its value in money, but was very silent about the effluent, or held that nothing could be done. An Act might be passed which placed rivers under inspection, and required "the best practicable means" to be adopted, and if such a measure was put in force uniformly, fairly, and gradually all over the kingdom, due regard being had to difference in the value of rivers as sources of potable water, food supply, etc., then some very considerable improvement might in time be brought about.

Professor J. Campbell Brown said: In this matter

there were two opposing interests; on the one side there was the interest of the manufacturer and the public who used his products. Every one would agree that our manufactures ought not to be needlessly hampered; and most people would agree that they must not be altogether stopped, even if some of our rivers had to be spoilt, and they ought not to forget the interest of future manufacturers, although that might have little weight compared with that of those already established. On the other side there was the interest of the riparian owners, the riparian tenant-farmers, and all those various interests that were represented by conservancy boards, including the people who fish in the streams, whether for food or for sport. The object of legislation ought to be to give the maximum of freedom to each side, with the minimum of interference with the other. This being the case, he did not think he could altogether agree with Mr. Muspratt, when he said that no legislation ought to interfere with the impurities cast into the stream by manufacturers until after sewage was dealt with, because although no doubt large quantities of sewage impurities cast into a stream were very prejudicial to health in every way, still the introduction of moderate quantities of sewage did not interfere with the fish, did not interfere with the farmer, did not injure his cattle, although it rendered the river useless for domestic purposes. But the introduction of effluent water from some factories would destroy the river for any useful purposes, except for carrying certain refuse materials into the sea. For instance, paper makers could keep out of the rivers nearly the whole of the poisonous esparto resin, and they might also keep out the largest portion of the fibrous matter, and after recovering most of their alkali, they might neutralise the remainder by some of the acid which they used for bleaching purposes, and then the effluent water would not destroy the fish. He thought every reasonable man would agree that the paper makers, for instance, ought to be compelled to bring their effluent water up to that standard of purity. In some other cases he thought it was very likely that legislative powers could not be put in force with any degree of stringency, without great hardship. He did not see any other way out of the difficulty than by agreeing that there should be different standards for different streams. There might be some streams devoted to manufactures, and others devoted to the riparian owners and the tenants. He entirely agreed with Mr. Muspratt in all he said with regard to standards, and he did not think that they could fix standards which should be applicable to all rivers, and which it would be just or convenient to make compulsory through the whole country. It was utterly impossible, and he did not think it was at all necessary or desirable. If standards could be agreed upon, they would no doubt greatly assist the inspector; they would define his work, and by a chemical analysis he would be able to prove his case easily in a court of law. But an Act of Parliament should be for the benefit not of the inspector only but of the whole nation. Every stream should be treated on its own merits, taking into consideration its condition before the effluent water passed into it, and the use made of the river below, and also the importance of the manufacture, and the possibility of purifying the effluent water at a reasonable cost. If it did cost the manufacturer some money he ought to be called upon to bear it for the good of the public. Where it would be ruinous to an important manufacture to purify the effluent water, such manufacture should be allowed to flourish only on certain rivers which were not reserved for fish and for other purposes.

Mr. Sinclair pointed out that the Bill had been brought in by three private members and not by the Government, and he thought it would be utterly impossible to get the Bill into a shape that would be acceptable, and it ought to be opposed until it was preceded by a General River Conservancy Bill brought in on the responsibility of the Government. Looking at his notes on the old Bill of 1873, he found that some of the most objectionable tests which were struck out of that Bill by the Committee of the House of Lords, to whom it was referred, were reintroduced in the present Bill. When the rivers pollution question was dealt with they should take care that no proceedings were taken except with the sanction of the Local Government Board, and that nothing should be required from the manufacturer that was not reasonably practicable, and that he should not be subject to prosecution when he kept within the prescribed tests. The Local Government Board should make more use of the power they had to make local sanitary authorities do their duty. He made this remark, because the Local Government Board did not exercise the power they now had in their hands.

Mr. Henry Brunner could not agree with that clause in the Bill by which any aggrieved individual could compel the sanitary authority to take proceedings. He thought the authority which made the law ought to have the power of enforcing it and the responsibility for its being carried out. At present if a man could prove injury, he had his remedy at common law, but it was the cost of obtaining that remedy that deterred people, and thus rivers continued to be polluted. Under the Bill as proposed, a great amount of vexatious litigation would arise. He doubted whether county boards would form a proper authority for dealing with this matter, and should prefer one central authority. He thought the question of fixed standards extremely objectionable, and not likely to attain the desired object, as they would enable either sanitary authorities or manufacturers, so long as they were within the standard, to turn into a pure stream matter which would nevertheless pollute it, and although some of our rivers were little better than common sewers, it was desirable that some at least of the others should be kept as pure as possible. Though he was of opinion that pollution by sewage matter most of all required consideration and attention, he did not think that the prevention of river pollution was specially directed against the manufacturing interests of the nation. If the law said from the beginning that no sanitary authority or manufacturer should be allowed to turn into a stream matters of worse character or in greater quantity than the water of the stream already contained, and that the state of the stream itself should be the standard of purity for that stream, he believed that such a law would assist in the development rather than restrict the progress of manufacturing industry. But in Lancashire probably elsewhere also—they had had instances where beautiful streams of pure water had been purposely polluted by manufacturers with the object of preventing their use by possible competitors. He thought that the true interests of manufacturers lay in preventing the pollution of rivers as far as possible, and certainly no individual or collection of individuals should have the right of so polluting a stream, whether for their own profit or convenience, that no one else could use it after them.

Dr. Hurter thought that the Bill met some of the objections raised by Dr. Hewitt by Clauses 7 and 8, which provided that existing rights should not be affected by the provisions of the Bill, but the exact meaning of those clauses could only be made out by

lawyers. As regards the standards of purity, Professor Mills, when discussing them at Glasgow, considered some of them not sufficiently stringent to preserve the life of fish. Now, it appeared to him (Dr. Hurter) that it was not required that fish should be able to live in the fluids discharged from works into the rivers, but only in the mixture of the polluting fluid with the river water. Dr. Hugo Fleck, an eminent German chemist, had lately published a small pamphlet on the pollution of rivers in Saxony, and from this little book Dr. Hurter gathered Dr. Fleck's opinion on the subject. Dr. Fleck thinks that we cannot expect anything from river water but that it shall be sufficiently clean for washing purposes. He considers a river as the natural drain of the river valley. Dr. Fleck thinks that in determining the permissible pollution regard must be paid to the amount of water passing through the cross section of the river and also to the velocity of the stream. He thinks it would be no use to forbid the industrial establishments to pollute a river so long as the much larger pollution from town sewage is not excluded, because the pollution from sewage is usually much the most serious. In many instances it was found that the polluting matter from factories reacted upon the polluting sewage matters so as to purify the river. Dr. Fleck sums up with the following words:—"If we regard the rivers in the first place as the natural drains of the valleys, then we shall have to renounce the maintenance of a large stock of fish in a river in all cases where a large population, with numerous industrial establishments, inhabit the river valley. No rules would ever be able to keep out of a river everything that might prove a disturbance to fish life, where a river was at the same time in the service of both domestic and industrial life. Very often the effluvia of industrial establishments were represented as the cause of the decrease of fish, without any regard to the fact that the sewage of dwelling-houses might often have its influences. It was proved that the water-worms (*naïdæ*), who were the greatest enemies of roe, were found in those deposits of mud which were rich in fœcal matters. Wherever a river was in the service of manufactories it would be impossible to make rules of Parliament which would re-establish in the river a large stock of fish." Thus Dr. Fleck's opinion goes a long way towards making each river its own standard—*i.e.*, towards the suggestion of the Chairman.

Mr. Muspratt, replying on the discussion, said he did not mean that county boards alone should be the authority, but what he meant was that if conservancy boards were appointed for different rivers, or drainage areas, the county boards should be represented on the conservancy boards. He agreed with Dr. Hewitt in the Local Government Board having supervising power. They must have a central authority to see that all interests throughout the country were equitably and properly dealt with. He also agreed that it was absolutely impossible to fix standards at present, but it might be possible after they had had a lengthened experience, and after investigation by the new boards, who might take the whole question into consideration. They would have to consider the interest of each locality, and the best practical means of dealing with the pollutions in that locality. Dr. Campbell Brown scarcely agreed with him that the sewage should be first dealt with; but after all, sewage was the greatest source of pollution, and even in an æsthetic point of view, they should have regard for the nose as well as the eye. He certainly thought more progress might have been made if proper inspectors had been appointed under the Act. They wanted to find out the best practical means of dealing with the sewage, having regard to the reasonable cost. He thought the present Act gave ample power for dealing with pollutions. It insisted upon the best practical means being adopted for the prevention of pollution. He thought they were all agreed that this should be done. They did not want to continue the pollution, and he thought all that Dr. Brown said with regard to paper makers was perfectly just and right. Paper makers were like everyone else—bound to use the best possible means to prevent pollution. He thought the intention of the Act was strong enough, and it was only a question of carrying out that intention. He therefore proposed that that meeting of the Liverpool Section of the Society of Chemical Industry "was of opinion that the Rivers Pollution Bill of 1884 was inadequate to secure the objects of its promoters, and would be injurious to the interests of manufactures, and recommends its early consideration by the Council of the Society, with a view to such action as the interests of industrial chemistry might require."

Mr. Carey seconded the motion, and it was carried unanimously.

THE LOSS OF ALKALI OCCASIONED BY SULPHUROUS ACID IN THE LEBLANC PROCESS.

BY J. W. PRATT, F.C.S.

The question indicated by the title of my paper relates to one of the last stages of the manufacture of alkali by the Leblanc method.

The sulphate of soda produced in the earlier stages of the manufacture has already been decomposed, and the resulting black-ash lixiviated to yield the soda in solution before the loss which I have attempted to trace is set up. Once the alkali is obtained in solution as vat liquor, it is only necessary, in order to procure the various solid soda ashes, etc., to subject it to evaporation and concentration. In English works the concentration of the vat liquor is usually effected by causing it to flow from the vessels in which it has been prepared and settled, into long open pans attached to the rear of the revolving or hand black-ash furnaces, where the flame and residual heat play freely over its surface.

As the evaporation progresses, monohydrated carbonate of soda or "salts" separates out and a mother, or "red liquor," remains. The salts are removed by fishing, and the "red liquor" is also run off from time to time.

Further manipulation converts the "salts" into the purest form of commercial soda or carbonated ash, and the "red liquor," in which the original impurities of the vat liquor are concentrated, into caustic ash. But the initial concentration which leads to this subdivision of products, and to so large an amount of water being evaporated economically, is not without its attendant disadvantages. One of these is the introduction of foreign matters into the alkali through the agency of the fire gases, which consist essentially of carbonic acid and oxide, unburnt oxygen, and invariably a small proportion of sulphurous acid, due to the sulphur present in the fuel employed. It is with the action of this last gas, sulphurous acid, that my experiments have to deal. The other gases, excepting the action of the CO_2 on the causticity of the liquor, are inert or at any rate harmless. But sulphurous acid being easily absorbable by the alkaline solution, leads to the formation of sulphites or hyposulphites subsequently oxidised to sulphate, and the alkali thus neutralised is to all intents and purposes lost. This loss of alkali has been variously estimated. Weldon* has estimated it at about 2 per

* Journ. Soc. Chem. Ind., January, 1883.

cent., and Moorhouse* at from 0·10 per cent. to 0·20 per cent. sulphur on the soda-ash made.

The figures given below, on which my estimate is based, are the results of experiments carried out at two independent works of the Runcorn Soap and Alkali Co., Limited, with the kind permission of the general manager, Mr. Charles Wigg. During two periods, some months apart, I had taken for me at each works average weekly samples of the coal used for firing the furnaces, and of the vat and red liquors, salts, carbonated and caustic ashes produced.

The workmen took small portions of each of the substances daily for a week, and these weekly average samples were then divided down and analysed. After analysis, the weight of the substances being known, and their ratio one to another having been previously calculated over long periods of production, all the required data were to hand.

The total alkali was estimated in each sample, likewise the sulphide, hyposulphite, and total sulphate after oxidation with hypochlorite, acidification and precipitation as barium sulphate. All the results are calculated on 100 of Na_2O, after deduction of the Na_2O existing as sulphide. The total iodine consumed in the titration of the solutions, after deduction of that due to the sulphide, is reported as hyposulphite, according to the method usually practised in alkali works laboratories. I have so reported it in order to avoid complication and possible error through the employment of not very reliable methods for the determination of sulphite, hyposulphite, sulphide, sulphate and total sulphate when existing together in one solution. This arrangement can only affect the relative amounts of sulphate of soda mechanically and chemically introduced in the preliminary experiments.

The analysis which follows is the average of several months, and will serve to show the general composition of the vat liquors dealt with :—

Na_2O	=	100
$NaHO$	=	26·75%
Na_2S	=	2·87
$Na_2S_2O_3$	=	1·02
Na_2SO_4	=	·58
Total Na_2So_4 after oxidation	=	6·81
$NaCl$	=	10·16
$Na_4Fe(CN)_6$	=	·313
Na_2SiO_3	=	2·68
$Na_2Al_2O_4$	=	1·50
Iron	=	0·213†

The fuel employed was almost entirely derived from one source, and hence does not present much divergence in composition. So far as the present subject is concerned, the only point of particular interest is the amount of volatile sulphur it contains, as that of course leads to the formation of the deleterious sulphurous acid in the fire gases. Its analysis gives :—

Fixed carbon	=	57·50%	
Volatile matter	=	29·25	= volatile sulphur 1·7%
Ash	=	8·25	
Moisture	=	5·0	
		100·00%	

A. WORKS, OCTOBER, 1881.—No. 1 EXPERIMENT—INITIAL EVAPORATION.

The pan attached to the revolver in this works measures 28 × 8 × 1·5 feet, and contains 336 cubic feet liquor, exposing a surface of 224 square feet.

"Salts" made = about 60 tons per week.

Total Na_2O dealt with—about 50 tons per week.

120 firing coal to 100 Na_2O.

Ratio Na_2O as "salts" to Na_2O as red liquor—1·5 : 1.

	Vat Liquor.	Red Liquor.	Salts.
Na_2S =	1·89	5·15	nil.
$Na_2S_2O_3$ =	1·52	5·60	·57
Total Na_2SO_4	7·12	23·80	2·32

$$\frac{(23{\cdot}8 \times 40) + (2{\cdot}32 \times 60)}{100} - 7{\cdot}12 = 3{\cdot}79 \text{ increase of}$$

sulphate of soda on 100 of Na_2O. This figure will of course include the sulphate of soda mechanically carried over by the draught of the furnace through the revolver. The hyposulphite calculated on the above basis

$$\frac{(5{\cdot}6 \times 40) + (0{\cdot}57 \times 60)}{100} - 1{\cdot}52 = 1{\cdot}06\%\ Na_2S_2O_3$$

in 100 of Alkali. These results give the alkali neutralised and lost by sulphurous acid as being ·41% Na_2O, and the increase in total sulphate

Mechanically carried over	=	1·89%
Due to increase in $Na_2S_2O_3$	=	1·90
Increase in total Na_2SO_4	=	3·79%

A. WORKS.—No. 2 EXPERIMENT—JANUARY 11, 1885.

	Vat.	Red.	Salts.
Na_2S =	2·526	5·57	nil.
$Na_2S_2O_3$ =	1·310	4·43	0·8
Total Na_2SO_4 =	7·90	21·43	2·57

$$\frac{(21{\cdot}43 \times 10) + (2{\cdot}57 \times 60)}{100} - 7{\cdot}90 = 2{\cdot}21\% \text{ increase}$$

Increase in hypo = 0·95% = 0·372% Na_2O lost

Na_2SO_4 mechanically carried over	=	·51%
Na_2SO_4 due to increase in $Na_2S_2O_3$	=	1·70
Total Na_2So_4	=	2·21%

As the "salts" are removed and roasted into carbonated ash, and the red liquors are evaporated to form caustic ash, in furnaces where top heat is in each case employed, a further exposure to sulphurous fire gas is involved before the alkali is finished. The figures below show the extent of this loss :—

A. WORKS.—100 Na_2O.

	Salts to Furnace.	Finished Carbonated Ash.
Na_2S =	·013%	nil.
$Na_2S_2O_3$ =	·930	·375
Total Na_2SO_4 =	1·470	1·900

1·9 – 1·47 = ·43% increase of sulphate or a loss of ·187% Na_2O on 100 of alkali.

	Red Liquor.	Caustic Ash 48%.
Na_2S	2·117	·22
$Na_2S_2O_3$	5·605	(Na_2So_3) 6·32
Total Na_2SO_4	20·813	21·64

·827% increase of Na_2So_4 = ·360% Na_2O lost.

Taking the mean of the two first experiments, and proportioning the amounts of alkali lost in finishing the two ashes, we find the total loss of alkali and increase in sulphate of soda on 100 of Na_2O to be thus arranged :—

				Na_2O lost.
Na_2SO_4 mechanically introduced	=	1·20%	=	—
,, chemically introduced	=	1·80	=	·391%
,, carb. ash (1·5) furnaces	=	·258	=	·112
,, caustic ash (1·0) furnaces	=	·331	=	·141
Total introduced	=	3·589%	=	·647%

This finishes the experiments at Works A, and the figures which follow are those obtained at the much larger works of the two.

B. WORKS.—NOVEMBER, 1884.

The samples are average ones from pans attached to two revolvers.

The dimensions of the pans are 46′ × 8′ × 2′ and 45′ × 6′ 7½″ × 2′, and they expose a joint area of 666 square feet to the flame, with a cubic capacity of 1332 cubic feet.

Salts made—about 170 tons per week.

* Trans. Newcastle Chem. Soc., 1871.

† Of this iron, 27% exists as sodium ferrocyanide, and 73% as ferroso-sodium sulphide, $Na_2Fe_2S_4$ ($4H_2O$).

Total Na_2O dealt with—about 130 tons per week.
Coal—104 : 100 Na_2O.
Ratio Na_2O as salts to Na_2O as red liquor—1·5 : 1·0.

NO. 1 EXPERIMENT.—NOVEMBER, 1884.

	Vat Liquor.	Red Liquor.	Salts.
Na_2S	= 1·36	3·121	nil.
$Na_2S_2O_3$	= 1·296	5·350	·341
Na_2SO_4	= 6·00	19·02	2·318

Calculated as before :—

Na_2SO_4 mechanically carried over	=	1·11%
„ due to $Na_2S_2O_3$ acid	=	1·88
Total increase	=	2·99%

Loss of Na_2O = ·412%

NO. 2 EXPERIMENT.—JANUARY, 1885.

	Vat Liquor.	Red Liquor.	Salts.
Na_2S	·575	1·268	nil.
$Na_2S_2O_3$	1·718	6·94	0·147
Na_2SO_4	6·816	23·150	2·411

This experiment gives :—

Na_2So_4 mechanically carried over	=	1·492
„ due to increase in $Na_2S_2O_3$	=	2·40
Total increase	=	3·892

Loss of Na_2O = 521%

B. WORKS.—FURNACING OF SALTS.

Coal to 100 Na_2O as Carb. ash = 0·9560 : 1.

	Salts.	Finished Carbonated Ash.
Na_2S	nil.	nil.
$Na_2S_2O_3$	·341	·282
Na_2SO_4	2·3185	2·775

2·775 – 2·3185 = ·46% increase of sulphate.
Loss of Na_2O = ·2%

B. WORKS.—RED LIQUOR TO CAUSTIC ASH.

Ratio coal to 100 Na_2O as caustic ash = 2·18 : 1·0.

Na_2S	3·121		0·173
$Na_2S_2O_3$	5·350	Na_2SO_3	6·740
Na_2SO_4	19·020		20·382

Increase of sulphate = 1·362%
Loss of Na_2O = 0·6%

Taking the mean of the two pan experiments, and proportioning the increase of sulphates in the two ashes, we find the total amount of sulphate capable of being introduced—from beginning to end of the operations—to be thus distributed on 100 of Na_2O :—

				Na_2 lost.
Na_2SO_4 mechanically carried over	=	1·301%	=	—
„ due to hyposulphites	=	2·140	=	·468%
„ introduced in furnacing	=	·82	=	·36
Total introduced	=	4·261%	=	·828%

It will now be noticed that these figures place the amount of total sulphate introduced about five times higher than the estimate of Moorhouse, and approximate more closely to that of Weldon. Of course it will be readily apparent that differences of conditions and environment may account to a large extent for the divergence. As regards the proportion of the total sulphur in the fuel employed absorbed by the alkali in course of manufacture, the ratios which I have established in the various stages as subsisting between fuel and Na_2O dealt with, afford the necessary data. In A Works, the proportion of sulphur absorbed from beginning to end of the operations is 7·42%.

In B Works the percentage is 10·1%.

Analysis of the revolver gases for sulphurous acid before entering and after leaving the salting-down pan place the proportion rather higher.

To sum up, my figures, when averaged, would point to the following conclusions, which I have drawn up in a tabulated form on 100 Na_2O :—

	Alkali lost.	Sulphate introduced.
Salting-down pan	·43%	3·22%
Carbonated ash (1·5) furnaces	·116	·267
Caustic ash (1·0) furnaces	·192	·41
	·738%	3·927%

Finally, it might be of interest to the members if those who have worked with pans fired from underneath would state in how far the extra fuel employed in that method compensates for the above and other disadvantages of the overhead evaporation of alkaline liquors.

Newcastle Section.

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Vice-Chairman: B. S. Proctor.
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Alfred Allhusen.	F. S. Newall.
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John Glover.	J. F. Stark.
John Morrison.	T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Next Meeting, April 23rd.—"On Insecurity of Written and Printed Documents," by Mr. J. Jameson. "Some Account of Recent Progress with the Jameson Coking Process," by Mr. J. Jameson. "On some Practical Results of the work done by Messrs. Black and Larkin's Patent Salt Cake Furnace at the St. Bede Chemical Company's Works, East Jarrow," by Mr. W. Rennoldson.

Meeting held 5th March, 1885, in the Lecture Theatre of the Durham College of Science.

MR. B. S. PROCTOR IN THE CHAIR.

ON THE PROPOSED STATUE TO NICOLAS LEBLANC; ON THE RECOVERY OF SULPHUR FROM ALKALI WASTE; ON A FURNACE FOR CHEMICAL OPERATIONS WHICH IS NEITHER AN OPEN FURNACE NOR A CLOSE FURNACE; AND ON THE MANUFACTURE OF CHLORINE FROM OXYCHLORIDE OF MAGNESIUM.

BY WALTER WELDON, F.R.S.

In the Address which I had the honour to deliver in this theatre in July last, I spoke as though a statue had been recently erected in France in memory of the author of the most beneficent chemical invention which has yet been made by man, Nicolas Leblanc. No such statue has, however, been erected; and I am here this evening mainly for the purpose of correcting, on the spot at which it was committed, the error on this point into which I then fell.

Within the preceding eighteen months, I had read, not in one journal only, but in many journals, that a certain municipality had decided to erect a statue to Leblanc. I had read in the *Comptes Rendus*, that eloquent address to the Académie des Sciences, by its then Perpetual Secretary,—not only the greatest chemist, but nearly if not quite the greatest orator of his time: Jean Baptiste Dumas, now, alas! no longer among us,—which commences: "La municipalité d'Issoudun a résolu de consacrer par un monument la mémoire d'un glorieux enfant de cette cité, le créateur de l'industrie de la soude artificielle." And I shared, not only with many of my own countrymen, but with many Frenchmen, the belief that this resolution had been carried into effect.

The statement founded upon this belief which I made here in July has been reported in the Journal of our Society. It ought therefore to be corrected therein. Except, however, abstracts of matter published elsewhere, nothing can appear in our Journal

which has not first been communicated, either to the Society at large, or to one of its Sections; and hence the main motive of the communication which I have sought permission to make to its Newcastle Section this evening.

The project of erecting at Issoudun a monument to Leblanc dates from 1856: the year of the publication of that famous "Rapport relatif à la Découverte de la Soude Artificielle," drawn up by Dumas, on behalf of a Committee of the Academy of Sciences consisting of Dumas, Thenard, Chevreul, Pelouze, Regnault, and Balard: which establishes so conclusively that Leblanc really was the author, and the sole author, of the process which bears his name, and that the attempt of one of his old partners, Dizé, to claim the credit of that great invention was dishonest and unfounded. It was then believed that Issoudun was Leblanc's birthplace; and the leading Literary Society of the ancient province of Berry, of one division of which Issoudun is the capital, initiated the idea of erecting there a monument to the man most useful to his fellows that that province could claim to have produced. Only local subscriptions were sought; few were obtained; and the project had to be abandoned. It was revived in 1877, and again in 1881; in each case with the same result as in 1856. At length, in 1883, it was adopted by the "Consultative Chamber of Arts and Manufactures" of Issoudun, with the concurrence of the Municipal Chamber of that city; and for some months there seemed every prospect that this time it would certainly be realised. Only for some months, however; for in November, 1883, the first-mentioned of these two Chambers came to a decision with respect to it which shows that at Issoudun local patriotism is confined within most curiously narrow bounds.

One of the most remarkable figures in the intellectual society of Paris of to-day, is that of a distinguished painter, who for the last fourteen years has been afflicted with blindness — M. Auguste Anastasi. Humble in his estimation of the talent which enabled him to produce, before his great affliction fell upon him, works so esteemed by others that they have provided adequately for his later years, this chivalrous blind artist is proud indeed of one thing—namely, that he is a grandson of Nicolas Leblanc. In 1883, soon after the Chamber of Arts and Manufactures of Issoudun had decided to accomplish the erection in that town of a monument in memory of his illustrious ancestor, there came into the possession of this gentleman some family papers, which led him to doubt the accuracy of the belief which at that time obtained with respect to the date of his grandfather's birth; and the researches which he at once set on foot with a view to clearing up this point resulted in the discovery, not only that Leblanc was born in 1742, and not in 1753, as had been believed for nearly three-quarters of a century, but also that he was born, not at Issoudun, but at a village near Issoudun — namely, Ivoy-le-Pré. M. Anastasi at once communicated this last-mentioned discovery to the Chamber of Arts and Manufactures of Issoudun: and the members of that body regarded it as showing that a statue to Leblanc in their unquestionably ancient but apparently not very enlightened little town "had no longer any *raison d'être*." Upon the principle of which conclusion, that statue of George Stephenson which one sees from the door of this building would have been in place at Wylam, but is out of place in the capital city of the district in which Wylam is situated.

The work which was thus abandoned by the Issoudunites is now, however, in course of accomplishment; and our own country, which is certainly the one which has profited most by the invention of the art of obtaining soda from salt, has an opportunity of taking part in it. It is now in the hands of a committee in which France is represented by nearly all her leading chemists, including Berthelot, Boussingault, Becquerel, Cahours, Debray, Frémy, Friedel, Péligot, and Schlœsing, by eminent men who are not specially chemists, including Pasteur, De Freycinet, and the Count de Lesseps, and by all her largest chemical manufacturers; and in which Germany is represented by Professor Hofmann of Berlin, Belgium by M. Solvay, and this country by three Vice-Presidents of our Society, Sir Henry Roscoe, Colonel Gamble, and myself. France has already subscribed liberally; thanks to M. Solvay, Belgium holds a prominent place on the subscription list; under the auspices of Professor Hofmann and Mr. Hasenclever, influential committees are being formed for the collection of subscriptions in Germany and Austria; and the three English members of the central committee have undertaken to bring the matter under the notice of every soda maker in Great Britain. The present is certainly not a propitious moment at which to ask British Leblanc soda makers to write cheques; and I am not concerned to try to maintain that to erect monuments to departed benefactors is our highest duty. But it happens to be just now that the opportunity presents itself of doing for Leblanc what was long ago done in this country for James Watt,—I put it in that way, because I think that Dumas was certainly right in regarding the Leblanc soda process as the invention of the last century next in practical importance to the steam engine; it would at least be unbecoming that we, who manufacture twice as much Leblanc soda as all the rest of the world put together, should be surpassed by any other nation in our willingness to contribute to the acknowledgment now in question of the indebtedness of all mankind to an invention which exceeds in practical importance all others of modern times, one only excepted; and other countries are doing their part in the matter so well, that the total sum which one need wish to raise in this country in respect of it is so small,—say some £600 or £700 or so,—that if only every English soda maker would contribute something, the amount required from each would be quite inconsiderable.

Before passing to other matters, I would ask permission to mention that M. Anastasi has recently written a biography of Leblanc,* which was published at Paris last summer, and which I believe that Messrs. Hachette & Co., of 18, King William Street, Strand, London, would send by post to any one in Great Britain in exchange for two shillings. Though its details are necessarily scanty, it tells the story of Leblanc's career much more fully than that story had been told before; and a more deeply pathetic history of a human life is scarcely, I think, to be found in all literature. Of the new facts stated in it, I will leave to be gained from the book itself all but just one: from which it appears that in travelling to Paris by Calais or Boulogne one probably traverses, and if one does not actually traverse, passes within a stone's throw of, the spot where black-ash was first manufactured, and the spot on which Leblanc died by his own hand. It is usually stated that his death took place in a hospital for the poor, but it really took place in his own house; that house was within the walls of his works; and upon a portion of the site of his works now stands the railway station of St. Denis.

Having thus corrected the inaccurate statement

* "Nicolas Leblanc; sa Vie, ses Travaux, et l'Histoire de la Soude Artificielle." Par. Aug. Anastasi, ancien artiste peintre, Chevalier de la Legion d'Honneur, petit-fils de Nicolas Leblanc. Paris: Hachette.

made by myself in this theatre last July, I will ask permission to proceed to refer to certain comments on the process proposed by Dr. von Miller and Herr Opl for the recovery of sulphur from alkali waste, which occur in the very interesting paper by Professor Divers which was read before this Section at its meeting in November. Of the value and importance of Dr. Divers's work on the chemical history of calcium sulphides and hydrosulphides, it would be difficult to speak too highly; but he has been misled—evidently in large measure by imperfect information with respect to Von Miller and Opl's methods of procedure—into basing on some of the results of that work quite erroneous conclusions with respect to a process, one part of which might, I think, be turned to account in this district.

After having pointed out two very real objections to an earlier proposal, by Herr Opl only, for causing the calcium sulphide of alkali waste to enter into solution as calcium sulphydrate, and having added that "a third objection is that calcium sulphide is too slow for technical purposes in combining with hydrogen sulphide, according to our experiments on the small scale," and that "a fourth difficulty is that the calcium hydroxide, and some, at least, of the carbonate always present in alkali waste, have also to be saturated with hydrogen sulphide," Dr. Divers goes on to say: "Opl's later process, or, rather, Opl and Von Miller's process, is equally unpromising. A solution of calcium hydrosulphide having been prepared from alkali waste, this is to be made, by boiling, to give up its hydrogen sulphide. Part of this is to be converted into sulphur or sulphuric acid at pleasure, and the rest is to be used in preparing a fresh solution of calcium hydrosulphide by dissolving out with it in water the sulphide of alkali waste. Not only are there the objections which apply to the other process, that hydrogen sulphide by no means quickly and readily dissolves calcium sulphide, and that it has to saturate the free lime in the waste, but there are obviously others. A solution of calcium hydrosulphide only slowly decomposes, even when vigorously boiled, unless the atmosphere over it is rapidly changed and the liberated hydrogen sulphide in this way carried off; and, therefore, the expulsion of the last portions of hydrogen sulphide will involve the generation of much steam, and this steam has to be condensed and the gas cooled before it comes to the moist waste. Another difficulty to be met, is to force this gas into the closed vessel holding the waste, since without pressure it could never be passed with any speed into the waste and yet be all absorbed."

Now, to deal first with those of these supposed objections to the process of Messrs. von Miller and Opl which relate to that portion of it which consists in treating waste by H_2S, in order to bring the calcium sulphide of the waste into solution as calcium sulphydrate, this part of that process has been in industrial operation for now nearly two years, and experience has shown that it is open to Dr. Divers's criticism of it only on one point. The operation is not performed in "a closed vessel;" it involves no "forcing," or pumping, of sulphuretted hydrogen, either "under pressure" or otherwise; the sulphuretted hydrogen is absorbed as rapidly as it can be practically supplied; and although that sulphuretted hydrogen does react on any calcium hydrate contained in the waste treated by it, if it attacks at all the calcium carbonate of the waste, the extent to which it does so is quite inappreciable

With pyrites at threepence per unit, it is obvious that a process directed solely to the recovery of sulphur from alkali waste, and yielding that sulphur only as sulphuretted hydrogen, can have little chance of adoption; and hence, at least until there shall have been realised some very cheap method of treating H_2S for the separation of its sulphur in the free state, those of the proposals of Dr. von Miller and Mr. Opl which are criticised by Dr. Divers in the passages which I have quoted, taken by themselves, would have little or no practical interest. It is only because one of those proposals has been proved applicable with advantage as part of a process, having a certain interest for this district, of which the recovery of sulphur from alkali waste is simply a secondary result, that I take this opportunity of submitting to you certain facts relating to it with which Dr. Divers, when he wrote his paper read here in November, was obviously unacquainted.

While it was at the Alkali Works of Hrüschau, in Moravia, of which Dr. von Miller is one of the proprietors, Mr. Opl being chemist there, that the treatment by H_2S of a mixture of waste and water, so as to dissolve out the calcium sulphide of the waste as calcium sulphydrate, was first put into execution: as soon as this method of getting the sulphur of waste into solution was found to be a really practicable one, it was put aside at Hrüschau, pending the result of that work in respect of methods for the obtainment of the sulphur of calcium sulphydrate as free sulphur which Dr. von Miller and Mr. Opl are still earnestly pursuing. Almost simultaneously, however, with its proposal by these chemists, simply as a step towards the recovery of sulphur, it was proposed also, by M. Lombard, of Marseilles, as part of a process for the manufacture of "dicalcic phosphate;" and that nearly two years' experience of it to which I have referred has taken place, not at Hrüschau, but, in connection with this process of M. Lombard's, at Rassuen, in the south of France.

The old method of manufacturing "dicalcic phosphate" consists in dissolving a suitable phosphatic material in aqueous hydrochloric acid, and then precipitating the phosphoric acid of the resulting solution by means of finely divided calcium carbonate. The phosphate obtained in this way, however, is never pure, by reason of some of the calcium carbonate always getting so coated with insoluble phosphate that contact between it and the solution in which it is present cannot take place. Seeking to become able to obtain a richer precipitated phosphate than had as yet been obtained industrially, and seeing that he could hope to do this only by means of a precipitant which could be employed in the state of solution, M. Lombard was at length led to the idea of employing as the required precipitant solution of calcium sulphydrate, obtained by dissolving the calcium sulphide of alkali waste in aqueous solution of sulphuretted hydrogen. The process in which he does this was got to work at Rassuen, on a small but industrial scale, early in 1883; it has been in operation there ever since; and a much larger than the original plant for it is now being constructed there.

Of the sulphuretted hydrogen which is liberated in the first operation of M. Lombard's process, by the reaction upon each other of solution of phosphoric acid and solution of calcium sulphydrate, half of course corresponds to the sulphuretted hydrogen which was used as such in the preparation of that solution of calcium sulphydrate, and must be employed for the preparation of another quantity of solution of that body, only the remaining half of it being available for the separation of free sulphur from it, or for use, as at Rassuen, as a source of SO_2. The H_2S, however, is not, as Dr. Divers supposed when he wrote the paper read here in November, divided initially into two portions: one to be sent directly to burners, and only the other into the apparatus in which it is to react on waste; but the

whole of the sulphuretted hydrogen is sent, not into a "closed vessel," containing merely "moist waste," but into the first of a series of three vessels, charged with a mixture of waste with more than its weight of water: the first of which three vessels communicates with the second, the second communicating with the third, the third communicating with apparatus for the combustion of H_2S into SO_2 and vapour of water, and this last communicating with vitriol chambers. Each of the three absorption vessels is furnished interiorly with a mechanical agitator, which is kept in motion throughout the operation performed in them. The whole of the sulphuretted hydrogen enters, as I have said, the first of the three vessels; a portion of it is absorbed in that vessel; and the remainder of it passes on into the second vessel. Of the H_2S which thus enters the second vessel, a portion is absorbed therein, the remaining portion passing on into the third vessel; and from the third vessel that portion of the sulphuretted hydrogen entering it which is not absorbed in it passes on to the combustion apparatus. The H_2S has not to be forced into the absorption vessels, but is drawn into them: partly by the draught occasioned by the absorption of some of it in those vessels, and partly by draught from the combustion apparatus and the vitriol chambers. The necessary division of the total quantity of H_2S into the proportion of it which may be burned, being the proportion of it, per operation, which represents the quantity of sulphur recovered from waste in that operation, and the proportion of it which may not be burned, and which may be regarded as one and the same quantity of H_2S, kept constantly in circulation, and used continually over and over again for dissolving calcium sulphide out of successive quantities of waste, is effected in the easiest possible way, simply by duly adjusting to each other the total quantity of H_2S evolved in each operation and the quantity of waste charged into the absorption vessels.

In M. Lombard's process,—and it is only in connection with some such process as his that there can as yet be any question of the preparation of calcium sulphydrate from alkali waste,—the only influence of the presence of calcium hydrate in the waste treated is to diminish the quantity of sulphur recovered from waste, in the state of sulphuretted hydrogen, obtained as a secondary product of the process, per given quantity of the phosphate which is its primary product. When there is no calcium hydrate in the waste employed, one ton of sulphur from waste is obtained, as sulphuretted hydrogen, per somewhere about three tons of dicalcic phosphate; and seeing that, at the present price of pyrites, a ton of pure sulphuretted hydrogen, for use merely as raw material of the manufacture of sulphuric acid, cannot be regarded as worth more than thirty shillings, for the quantity of secondary product, per that quantity of primary product, to be reduced, by the presence of calcium hydrate in the waste employed, to say eighteen hundredweight, is simply to make the cost of the primary product greater in the latter case than in the former by about one shilling per ton. As regards the calcium carbonate of the waste employed, it has practically no prejudicial influence whatever, sulphuretted hydrogen not attacking this constituent of waste until practically all its calcium sulphide and calcium hydrate have been dissolved out, beyond which point the operation is not carried; and though Dr. Divers supposes, I believe erroneously, that sulphuretted hydrogen generated from solution of calcium sulphydrate by Dr. von Miller's method, "must be cooled before" it can be used for the preparation of a further portion of sulphydrate, in M. Lombard's process, at any rate, the H_2S does not require cooling, being evolved at a temperature little, if at all, above that of the atmosphere. Lastly, the operation of bringing into solution as calcium sulphydrate the calcium sulphide of alkali waste, by the method which I have described, is not a costly operation: requiring fuel only for raising the small quantity of steam required to keep in motion the agitators in the absorption vessels, and labour only for raising that steam, charging those vessels, and discharging them.

We may, therefore, I think, take it that calcium sulphydrate is now readily and cheaply obtainable for use in any process, to be performed in or in the neighbourhood of Leblanc soda works, in which that body can be employed as a re-agent: provided only that the process be one—such, for example, as M. Lombard's—in which the sulphur of the calcium sulphydrate, or, if not the whole of that sulphur, at least half of it, is evolved as H_2S. For what cannot, I think, fail to become a very important industry in this district—namely, the manufacture of phosphates of lime from the phosphoric acid of the slag of the basic steel process, the question of using as the necessary precipitating agent solution of calcium sulphydrate prepared by the method of Messrs. von Miller, Opl, and Lombard, and so obtaining a richer phosphatic product that can be obtained by means of any other precipitant industrially available, and at the same time recovering the sulphur of an equivalent or nearly equivalent quantity of the calcium sulphide of alkali waste—certainly seems worthy of at least being studied.

As Dr. von Miller's method of decomposing the solution of calcium sulphydrate obtained by his, Opl, and Lombard's method can have very little practical interest until means shall have been realised of cheaply obtaining free sulphur from sulphuretted hydrogen, I will ask permission to devote to it only the very few sentences necessary to indicate its real nature—for the idea of it which is conveyed by Dr. Divers's paper is not an entirely accurate one—and its present position. Dr. Divers's statement that "solution of calcium hydrosulphide decomposes only slowly, even when vigorously boiled, unless the atmosphere over it is rapidly changed, and the liberated hydrogen sulphide in this way carried off," is of course absolutely accurate; but it has scarcely any relevance to Dr. von Miller's method of procedure, which consists, not in merely "boiling" the solution in question, but in evaporating it nearly to dryness. This method of procedure no doubt involves "the generation of much steam," and "this steam," as Dr. Divers says, "must be condensed;" but the condensation of steam is not a difficult operation, and the only practical question relating to that steam is, what is the cost of raising it? On this point Dr. von Miller informs me that such experience as he has yet had with respect to it leads him to conclude that the evaporation of the quantity of solution of calcium sulphydrate, the evaporation of which yields the quantity of sulphuretted hydrogen containing two tons of sulphur, being the quantity of such solution which in his process has to be evaporated per one ton of sulphur recovered from alkali waste, can be effected by 1·8 ton of slack, and that in his district, at any rate, the value, merely for use in agriculture, of the 2 tons 6 cwt. of chemically pure but very dense crystallised calcium hydrate which are obtained as a secondary product of the evaporation of the quantity of solution of calcium sulphydrate in question, is fully equal to the cost of performing that evaporation, for fuel and labour combined. The one difficulty which he has really had to encounter in his endeavour to realise on the large scale the decomposition of calcium sulphydrate by the mere evaporation of its aqueous solu-

tion is that of providing suitable vessels in which to perform that evaporation: vessels, the materials of which shall be attackable neither by calcium sulphydrate nor by hydrogen sulphide. He believes that he has recently come to see a satisfactory way out of this difficulty; but at this season building operations are impracticable at Hrüschau, and it will not be till towards the close of next autumn that the practicability or otherwise of his latest ideas on this subject will have been adequately tested.

Dr. von Miller is perfectly conscious that even when he shall have succeeded in obtaining command of suitable apparatus in which to effect the decomposition of calcium sulphydrate by his method, that method can have little practical value until it shall have been supplemented by a cheap means of decomposing sulphuretted hydrogen in such manner as to obtain its sulphur in the free state. Though hydrogen sulphide is by no means a very stable body, none of the many proposed such methods of decomposing it have yet succeeded on the large scale: even the Claus process, which at one time seemed very hopeful, having as yet given only incomplete results. Dr. von Miller is at present working on an idea for the accomplishment of the object in question, which, whether or not it be destined to prove more fortunate than its many predecessors, is at least interesting as constituting quite a new departure in its line: that idea being to burn the hydrogen only of sulphuretted hydrogen, not by gaseous oxygen, but by the solid oxygen of calcium sulphate.

Dr. von Miller has found that if sulphuretted hydrogen be passed over heated calcium sulphate, the calcium sulphate becomes reduced to sulphide, and there passes off a mixture of vapour of water and vapour of free sulphur. He has also found that if a current of air be then admitted to the residual calcium sulphide, the latter combines with some of the oxygen of the air thus admitted to it, with considerable evolution of heat, the original quantity of calcium sulphate being thus reconstituted for use again. The oxygen which combines with the hydrogen of the sulphuretted hydrogen treated by this process is thus atmospheric oxygen, but atmospheric oxygen no longer having nitrogen associated with it; so that if any of the sulphuretted hydrogen escapes decomposition in the first instance, or if any of its sulphur is oxidised into SO_2, the H_2S or SO_2, which in such case passes from the apparatus in which the process is performed, instead of being mixed, as under corresponding circumstances in the Claus process, for example, with so much inert gas as to preclude its utilisation, is mixed only with vapour of sulphur and vapour of water, and when these have been condensed out of it remains perfectly pure. At Oldbury, Messrs. Chance Brothers have made some small experiments on this process; and they have found that, in the laboratory at any rate, it is easy of execution, and that none of the sulphur of the sulphuretted hydrogen treated by it undergoes oxidation, provided only that the sulphuretted hydrogen be always sent into the apparatus containing the heated calcium sulphate at such speed that a slight proportion of it shall pass out undecomposed.

Other new processes for the recovery of sulphur from the residual product of the Leblanc soda process are now under experiment, but time will not permit me to touch upon them; and I will now proceed, with your permission, to briefly indicate the nature of the furnace invented at Salindres for use in the process of manufacturing chlorine from oxychloride of magnesium.

That method of manufacturing chlorine was first made public by the address, delivered in this theatre, to which I have already referred. Shortly afterwards, one of your members, who bears a name which must always hold a foremost place in the history of metallurgical invention, Mr. Hugh Lee Pattinson, junior, wrote to that great daily newspaper which is one of the many things for which this city is renowned far and wide, for the purpose of pointing out certain supposed objections to that process, in order, as he put it, "that an undue amount of importance" might "not be attached to" the address in which that process and certain probable consequences of it were touched upon, "by those unable, of their own knowledge, to supply a criticism" of it. For the comfort of such persons, Mr. Pattinson "supplied a criticism," one of the points of which was that the fundamental reaction of the chlorine process in question must be performed, either in an open furnace, in which case the chlorine yielded by it would be mixed with products of combustion, or "in a retort or close furnace," costly alike for fuel and for wear and tear. I replied that the apparatus in which that reaction is performed at Salindres is of the nature neither of an open furnace nor of a "close" one; and I have been surprised to find that there are those who have been unable to understand how this could be.

Our French friends have a proverb which declares that "a door must be either open or shut;" but it is not the case that a furnace must be either an "open" furnace or what we call a "close" one: meaning by an "open furnace," one the charge in which is heated by direct contact with the products of the combustion of the fuel employed, and by a "close furnace" one in which the charge is heated, without coming into contact with products of combustion, by heat applied to the exterior of the furnace, and transmitted to the charge contained therein through the material of which the furnace is constructed. There is of course another kind of furnace than either of these. A furnace which was in use before the dawn of history, the principle of which was known to and applied by pre-historic man, a furnace which exists to-day in greater numbers than any other, and which has rendered and is still rendering more important service to humanity than all other kinds of furnaces put together, is neither an "open furnace" nor a "close" one. Need I say that I refer to the baker's oven?

To prepare the staff of life, one has to roast small masses of a slightly fermented intimate mixture of flour and water. When he has charged these into his furnace, or "oven," the baker does not pour in upon them flame and heated products of combustion; and hence his furnace is not an open furnace. Nor does he apply heat to the exterior of his oven, and so roast his loaves by heat transmitted to them through the substance of its floor, walls, or roof; and hence his oven is not of the nature of a "retort or close furnace." What he does is to heat up his oven before his loaves are put into it, and the loaves are then roasted, or "baked," by means of heat which was applied to and stored up in the bricks of which the oven is constructed before the loaves entered it. The new chlorine furnace in question is upon precisely the same principle; and M. Pechiney and I, in speaking of it together, always call it the "four de boulanger."

It consists of a series of vertical chambers, the thickness of the dividing walls of which is considerably greater than the width of the spaces between them. Before charging these chambers with oxychloride of magnesium, products of combustion are passed through them, until their dividing walls are raised to a certain temperature. The products of combustion which have traversed the series of chambers go first through a regenerator and then to appa-

ratus in which most of the heat still retained by them is utilised for the evaporation of the solution of magnesium chloride with which the process commences. When the dividing walls of the furnace have been heated sufficiently, the admission of products of combustion is arrested, and the chambers are charged, through doors at the top of each of them, with magnesium oxychloride in small lumps. By absorption of some of the heat previously stored up in the massive dividing walls of the furnace, these lumps of oxychloride rapidly become raised to such temperature that the oxygen of the air which is now admitted into the furnace can react upon them, with the result that their chlorine becomes replaced by some of that oxygen, and that there passes off a mixture of free chlorine, nitrogen, excess of air, and vapour of hydrochloric acid: which mixture passes first to apparatus in which its vapour of HCl is condensed out from it, its gases then passing on into mechanical bleaching powder chambers. When this replacement of the chlorine of the magnesium oxychloride by atmospheric oxygen has become complete or nearly so, the residual magnesia is discharged by doors at the bottom of each compartment of the furnace, and the furnace is then ready to be heated up again, for another operation.

The furnace invented at Salindres for the oxychloride of magnesium chlorine process thus avoids equally both the alternative difficulties, one or other of which Mr. Pattinson declared that the process "must" necessarily encounter. The chlorine liberated in that furnace is not mixed with products of combustion, nor is the material treated in it heated by the costly method of transmitting to it, through the substance of the vessel containing it, heat applied to that vessel externally. To which allow me to add that the furnace is not costly of construction; that it is subject only to a moderate amount of wear and tear; that it is obviously economical of fuel; and that there seems every likelihood that the manufacture of chlorine from chloride of magnesium is by no means the only purpose to which it will prove capable of being applied with advantage.

To the chlorine process for which this furnace was invented, Mr. Pattinson further objected that the chlorine yielded by it is hot chlorine, requiring to be cooled before it can be applied to the manufacture of bleaching-powder: as though black ash did not require cooling before it can be lixiviated; as though it were an objection, alike to the Leblanc soda process and to the ammonia soda process, that the finished product of each respectively must be cooled before it can be packed into casks; as though it were a grave fault on the part of our method of manufacturing sulphuric acid that the gases from the pyrites burners must be cooled before they can enter the vitriol chambers; and as though it could matter in the least whether the chlorine had to be cooled or not, provided only that it be finally yielded, as chlorine which has been absorbed by calcium hydrate and has so become a constituent of bleaching-powder, more cheaply than chlorine manufactured in any other way. I may nevertheless point out that the operation by which the chlorine is cooled is not performed for the express purpose of cooling the chlorine, as Mr. Pattinson's "criticism" would imply that it is, but would equally have to be performed even if the chlorine were not hot at the stage at which that operation comes in: the case being one of a process yielding two distinct products, which two products, at an intermediate stage of the process, are mixed together, but neither of which is of any value until it is separated from the other, so that the process by which both are manufactured is not completed until the operation by which their separation is effected has been performed, and that to say of that process that the operation by which its two products are separated is an essential part of it is to criticise it only in the sense, if any, in which it would be a criticism of the Leblanc soda process to say that its intermediate product, black ash, has to be separated into sodium carbonate and calcium sulphide, or in which it would be a criticism of the ammonia soda process to say that it is necessary in that process to split up the hydrogen-sodium carbonate intermediately produced in it into normal sodium-carbonate, vapour of water, and free carbonic anhydride.

The two products are of course free chlorine and vapour of hydrochloric acid. Whereas, per 100 parts of the chlorine contained in hydrochloric acid treated by the old Weldon process, 30 parts are yielded as free chlorine and 70 parts as the chlorine of calcium chloride, per 100 parts of the chlorine of hydrochloric acid treated by the oxychloride of magnesium process, 50 parts are obtained as free chlorine, and the other 50 parts as HCl: the aqueous acid obtained by the condensation of which HCl may either be neutralised by magnesia and made to yield another 50 parts of free chlorine, or be applied to any other purpose which may be preferred. To whatever purpose, however, that HCl be afterwards applied, it must be separated from the free chlorine which is liberated concurrently with it, and the operation by which it is so separated yields the chlorine cool: no operation for the special purpose of cooling the chlorine being thus required.

Even, however, if the chlorine had to be cooled by an operation having no other object, what would that operation amount to? Supposing the mixture of chlorine and other gases to be not much more than half as rich in chlorine as it often has been, the volume, at the temperature of the atmosphere, of the quantity of it corresponding to a ton of bleaching-powder would be about 28,000 cubic feet, or scarcely more than one-sixth of the volume of the quantity of gases which has to be cooled, in the manufacture of sulphuric acid, supposing the gases from the burners to contain 7 per cent. by volume SO_2, from the temperature of the combustion of pyrites to that at which they enter the vitriol chambers, per ton of pyrites burnt. A single firm in this district, the Newcastle Chemical Works Company, burning 30,000 tons of pyrites per annum, cools per annum, from and to the temperatures I have mentioned—without Mr. Alfred Allhusen, I venture to say, considering that he is doing anything specially wonderful in so cooling a quantity of gases so enormous—about five thousand millions of cubic feet of burner gases: being a quantity little, if at all, inferior to the total quantity of gases which would have to be cooled in connection with the oxychloride of magnesium chlorine process, if there were manufactured by that process absolutely the whole of the chlorine at present produced by all the chlorine manufacturers in the world put together.

In conclusion, just four sentences, if you please, with respect to the dilution of chlorine by other gases, and the manufacture of bleaching-powder in mechanical chambers. One point of Mr. Pattinson's "criticism" was that the chlorine yielded by the process of which I have been speaking, and that yielded by a certain other process, being dilute, cannot be used in ordinary bleaching-powder chambers. So might it have been objected in the early part of this century to the proposal to use coal gas as an illuminating agent, that it could not be burned in the ancient candle-sticks. The candle-sticks have gone; and I express a most deliberate and carefully-weighed opinion in saying that the primitive bleach-

ing-powder chambers would have to follow them, even if there were no question of any change in the methods by which chlorine is manufactured. Mr. Pattinson said in the *Chronicle* that "it is always desirable, if not essential, to make it" (bleaching-powder) "with concentrated pure gas;" but that ancient superstition is not only not supported by experience of the use of dilute chlorine in mechanical bleaching-powder chambers, but all such experience goes to show that, even when manufacturing chlorine by methods yielding "concentrated pure gas," the wise course would be to deliberately mix air with that gas, in order to become able to absorb it by a method much more rational than the primitive method at present used exclusively everywhere, I believe, except at Salindres: by a method, that is to say, which not only avoids all loss of chlorine, and all nuisance arising from such loss, and is very much more rapid than the ordinary method, but which also yields much more stable bleaching-powder, and bleaching-powder much more uniform in quality, than can be manufactured by the old method, but which new method absolutely requires that the chlorine treated by it should be mixed with an inert gas, which may constantly carry off the heat liberated by the combination of the chlorine with calcium hydrate. Experience of that mechanical bleaching-powder chamber which Mr. Pattinson said that it had been "necessary to invent" for the absorption of the dilute chlorine yielded by the new processes in question, but which was really invented and used long before any experiments on those processes had been commenced at Salindres—for the absorption of the chlorine remaining in the atmosphere of ordinary bleaching-powder chambers, fed by strong chlorine from the old Weldon process, at the moment of taking down their doors, has proved conclusively that to say of a method of manufacturing chlorine that the chlorine yielded by it is diluted by other gases, provided only that those gases are inert gases, not capable of being absorbed by calcium hydrate, and that the degree of dilution is not too great, is to say that the chlorine manufactured by that process is better adapted, and not less well adapted, to the manufacture of good bleaching-powder, than if it were not diluted by other gases; and that to object to such a process that the chlorine yielded by it cannot be used in the old bleaching-powder chambers, is as though one should maintain that the modern railway system is inferior in advantage to the stage-coach system of our fathers, on the ground that railway locomotives cannot be run on ordinary roads.

DISCUSSION.

The CHAIRMAN: The formal discussion of Mr. Weldon's paper will take place, of course, at our next meeting; but as Mr. Weldon may not be able to attend our next meeting, perhaps those of the members present who would like to put any questions to him on the subject of his paper will do so now, while he is here to answer them.

Mr. JOHN PATTINSON: It would be interesting to know on what scale bleaching-powder is now being made at Salindres by the oxychloride of magnesium process. I presume that the magnesium chloride is obtained by decomposing by magnesia the ammonium chloride of the ammonia soda process?

Mr. STUART: Can Mr. Weldon give us any idea of the form and principle of the mechanical bleaching-powder chamber of which he has spoken? The Chief Inspector under the Alkali Acts has been pressing manufacturers to adopt some method of dealing with the residual chlorine remaining in the present chambers when the charge in them is ready to be packed, and his proposals on this point have not met with very general approval. Perhaps M. Pechiney's mechanical chamber might be a solution of the difficulty. I should also like to ask which process of manufacturing chlorine at present offers the greatest promise of future success—the oxychloride of magnesium process, or the chloride of manganese process?

Mr. MORRISON: What length of time is required for the operation of manufacturing bleaching-powder in mechanical chambers?

Mr. NIXON: What are the practical difficulties of decomposing oxychloride of magnesium by atmospheric oxygen? Is the whole of the oxygen of the air used absorbed? And is the bleaching-powder made from the dilute chlorine got up to full English strength?

Mr. WELDON: Up to the present time, the successive installations at Salindres for the oxychloride of magnesium process have been upon a semi-industrial scale; but a large industrial plant for it is now in course of construction there. The magnesium chloride hitherto used at Salindres as the raw material of the process in question has been that obtained in the salt gardens of MM. Pechiney et Cie., at Giraud, in Camargue, as the mother-liquor from the manufacture of salt, by natural evaporation, from sea water. The mechanical bleaching-powder chamber in use at Salindres was devised for the express purpose of absorbing the chlorine contained in ordinary bleaching-powder chambers at the moment of taking down their doors. It is upon the principle of the horizontal revolving cylinder which was tried at Gerard's Bridge, St. Helens, many years ago. Mechanical bleaching-powder chambers, however, cannot give good results with strong chlorine. When the chlorine used in mechanical chambers is sufficiently diluted by inert gases to carry off the heat generated by the reaction of the chlorine on calcium hydrate, mechanical bleaching-powder chambers yield as strong bleaching-powder as can be obtained in any other chambers. The time required for the operation of manufacturing bleaching-powder in mechanical chambers depends chiefly on the rate at which chlorine can be sent into the chambers, without raising the partially formed bleaching-powder to too high a temperature; and this depends chiefly on the degree of dilution of the chlorine. The one of the two processes referred to by Mr. Stuart which M. Pechiney and I believe to be the most promising, is the oxychloride of magnesium process. It presented a good many practical difficulties at first; but, thanks to M. Pechiney, and to the engineer of Salindres, M. Boulouvard (the inventor of a very successful form of the ammonia soda process), I believe they may all be regarded as having now been overcome. The whole of the oxygen of the air employed can be made to react on the magnesium oxychloride, but it is better to work so that only about half of it shall react.

Birmingham and Midland Section.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held March 4, 1885.

MR. CHARLES HUNT IN THE CHAIR.

NEW AND LITTLE-KNOWN APPLICATIONS OF THE NITROMETER.

BY ALFRED H. ALLEN.

Doubtless many of the members of the Society of Chemical Industry are in the habit of using the nitrometer, and if they have employed it for one particular purpose have probably been struck with its applicability to certain others which fall within the range of their requirements. Hence, I am prepared to find that most of the applications of the nitrometer which I intend to refer to this evening have already been made by individual members of the Society, and my excuse for bringing the matter forward must be the desirability of causing these applications made by individual members to come into more general use. Still, I believe I may claim that certain uses of the nitrometer to which I desire to call attention are strictly novel and original.

As long ago as 1847 (*Phil. Mag.* [3] xxx. 426), the late Walter Crum described a method of estimating the *nitrates* and analysing *gun cotton*, which consisted in passing up the nitrated substance, together with some water and sulphuric acid, into a graduated tube filled with mercury. The nitric oxide liberated in the reaction was subsequently absorbed by a strong solution of ferrous sulphate. The method of manipulation was greatly improved by Frankland and Armstrong in 1868 (*Journ. Chem. Soc.* xxi. 101), and recommended by them for the estimation of *nitrates in water*. Their use of a tube open at one end and closed at the other by a tap surmounted by a cup greatly facilitated the introduction of the nitrate and acid. This apparatus, which may be called the Frankland-Armstrong tube, would have come into more general use had the agitation of the lighter liquids with the mercury been more easy to effect, but the accuracy of the results yielded by it have been fully proved by Mr. R. Warington (*Journ. Chem. Soc.*, xxxv. 376), who also found that the presence of chlorides did not interfere to any notable extent with the amount of gas obtained.

Mr. G. E. Davis states that the idea of applying the mercury process to the assay of *nitrous vitriol* was suggested to him by Dr. John Watts in 1872; and, in a paper read before the Faraday Club on January 22nd, 1878, Mr. Davis fully described the use of the Frankland tube for the assay of vitriol, which tube he used in connection with a mercurial trough. In February, 1878, Mr. Davis informs me that he connected Frankland's tube to a piece of combustion tube by means of india-rubber tubing, and used the two side by side in a burette-stand. This arrangement constituted the first form of the instrument we now call the nitrometer.

The name "nitrometer" is due to Dr. Lunge, who in 1878 published and illustrated a description of his instrument (*Berlin Berichte*, xi. 436; *Dingler's Polyt. Journ.*, 228, page 447; *Chem. News*, xxxviii. 19).

To Dr. Lunge, then, belongs the credit of the first published description of the nitrometer, but the same instrument appears to have been devised independently at a somewhat later date by Mr. Campbell, then of the Hebburn Chemical Works.

Lunge's nitrometer possessed one decided improvement in the use of a three-way tap, which arrangement appears to have been adopted from Bunte's gas apparatus. When the nitrometer is employed for the estimation of nitrates, or the assay of nitrous vitriol, the three-way tap greatly facilitates the removal of the acid liquid at the end of an experiment, without necessitating the complete emptying of the nitrometer. Later on I propose to show that the nitrometer furnished with a three-way tap has such important uses and advantages of its own, that it almost deserves to rank as a distinct piece of apparatus.

As ordinarily employed, the nitrometer-stand is so arranged that the open or reservoir-tube must be removed from its position and brought into close proximity to the graduated tube, before the measure of gas in the latter can be read off, and it is therefore an advantage to have the stand so constructed that the closed and open tubes of the apparatus, which I propose hereafter to refer to as the "nitrometer" and "reservoir" tubes respectively, should be in close proximity.

Another inconvenience attending the use of the nitrometer is the persistent mercurial froth which remains after the completion of the reaction, and prevents the reading of the level of the mercury in the nitrometer tube from being taken without delay. When great accuracy is not required, this may be avoided by employing a tolerably wide tube; but, for ordinary purposes, it is preferable to adopt a plan suggested by me in a paper on the estimation of nitrates by the nitrometer, published in 1880 (*Analyst*, v. p. 181). In that paper, I proposed to make a mixture of sulphuric acid and water, in the same quantity and proportions as the acid and solution of nitrate are employed in the nitrometer-tube, and to pour this mixture on the top of the mercury in the reservoir-tube. It is then possible at once to bring the aqueous liquids in both tubes to the same level, and the incomplete separation of the mercury from the aqueous liquid becomes a matter of indifference. In the same paper, I proposed to make an experiment with a second nitrometer, in which a definite amount of nitre was used. By noting the volume of nitric oxide evolved in this apparatus, and comparing it with that obtained in the case of the liquid of unknown composition, it becomes unnecessary to make any correction for pressure or temperature; and the standard quantity of gas, when once obtained, can be kept in the tube without alteration for any length of time. If this course be pursued, it is desirable to keep a little strong sulphuric acid in the cup, to prevent any possibility of leakage.

Before leaving the question of the estimation of nitrates in the nitrometer, I may point out a source of error which appears not unfrequently to have been ignored. This is, that strong sulphuric acid has a notable solvent power for nitric oxide, and hence the full amount of gas cannot be obtained unless the sulphuric acid be diluted below that point at which its solvent power for nitric oxide becomes appreciable. Warington and Thorpe both recommend that the strong sulphuric acid and aqueous liquid should bear the proportion of three measures to two, and my own experience is in favour of this condition.

In experiments on nitrous vitriol, made by Mr. T. Bayley at my request, to test the extent of the error from absorption of nitric oxide, he found that in the case of acid of a density of about 1·62 the extra gas obtained after further diluting the acid was fully 0·5 cc. This source of error becomes more serious when stronger acid is employed, and is not improbably the cause of the low results obtained when an excessive quantity of acid is used for the assay of dynamite in the nitrometer.

For the examination of *dynamite* and *gun-cotton*, Lunge places about ·35 gramme of the sample in the cup of the nitrometer, and dissolves it in 5cc. of concentrated sulphuric acid. The liquid is then allowed to enter through the tap, and is agitated with the

mercury in the usual way. Probably better results would be obtained if a few centimeters of water were added after the completion of the reaction.

Hitherto all employers of the nitrometer appear to have regarded mercury as the only liquid with which the instrument could be filled, and of course this is actually the case in the estimation of nitrates, since the mercury itself takes part in the reaction.

For many purposes, however, the mercury can be conveniently replaced by a dense aqueous liquid, saturated brine being most generally suitable, and the following are some of the applications to which I have put the nitrometer when filled with such a liquid.

The assay of *spirit of nitrous ether* and kindred preparations for the proportion of ethyl nitrite is a problem which has engaged the active attention of pharmaceutical chemists. Hitherto the processes for the purpose have not been very satisfactory, the one giving results nearest to the truth being that of Eykman, which consists in treating the sample with a solution of ferrous sulphate and dilute sulphuric acid, heating the mixture, and collecting the nitric oxide gas evolved. Though the process is theoretically perfect, there are certain sources of error in practice, and the apparatus is somewhat complicated, and requires skill in management. Mr. D. B. Dott has proposed to estimate ethyl nitrite by treating it with potassium iodide and dilute sulphuric acid, and estimating the amount of iodine set free by titration with a standard solution of sodium thiosulphate. The reaction which occurs in this process is expressed by the equation :—

$$(C_2H_5)NO_2 + KI + H_2SO_4 = KHSO_4 + (C_2H_5)OH + I + NO.$$

In making experiments on Dott's method it occurred to me to measure the nitric oxide gas evolved, instead of titrating the iodine liberated, and as the reaction occurs completely and promptly at the ordinary temperature, the nitrometer is an apparatus well suited for the purpose. I have now had a large experience in the process, which is best performed in the following manner :—A nitrometer should be filled with strong brine, and 5cc. of the sample to be tested should then be placed in the cup of the nitrometer, and allowed to enter through the tap, taking care that no air gets in at the same time. About 5cc. measure of a strong solution of potassium iodide is next allowed to enter, and this is followed by about 5cc. of dilute sulphuric acid. Effervescence immediately ensues, and, if the tube be vigorously agitated at intervals, the reaction is complete in a few minutes, when the level of the liquid in the two limbs of the nitrometer is adjusted, and the volume of nitric oxide gas read off. There is no difficulty in confining the reaction to the liquid in the upper part of the closed limb of the nitrometer. The nitrometer method has been proved to give very good results with pure *sodium nitrite*, prepared from silver nitrite, and employed in known amount, and may be advantageously used for the assay of commercial nitrite of sodium. With some specimens of sweet spirit of nitre a considerable volume of nitric oxide is produced, and iodine liberated before adding the acid, the reaction probably depending on the presence of free acid in the sample. The results obtained in the nitrometer are remarkably constant, and the method furnishes a very easy means of assaying sweet spirit of nitre with considerable accuracy, which is further increased if a correction of 1·5cc. of NO be made for solubility of the gas. The process does not occupy ten minutes, including the calculation, and actually measures the nitrous compounds present in the sample, instead of leaving their proportions to be inferred from a more or less complex reaction, such as the reduction of permanganate, etc. When strictly accurate results are not required, as is rarely the case in assaying such a preparation, the volume of gas need not be corrected for variations of pressure, temperature and tension of aqueous vapour, etc. 1cc. of NO at the *ordinary* conditions of pressure and temperature corresponds to ·003184 gramme of ethyl nitrite,* and hence 5cc. of samples of spirit of nitrous ether of reasonably good quality evolve from 25cc. to 40cc. of nitric oxide.*

Another useful application of the nitrometer is for the estimation of *urea* in its urine. For this purpose the tube is filled with brine as before, and 2cc. of the sample introduced through the tap. This is followed by 10cc. of the usual solution of bromine in caustic soda.† Before the bromised soda has time to sink through the brine it comes in contact with the urine, and the great bulk of the nitrogen gas is liberated. By now placing a clip on the india-rubber connecting-tube and agitating the contents of the nitrometer tube vigorously, the reaction is completed, and the volume of gas may be read off. Not unfrequently the reading is delayed by the existence of froth on the surface of the liquid in the closed tube, but this may be instantaneously got rid of by introducing a few drops of alcohol through the tap. In some respects it is preferable to bring the bromised soda and urine in contact with each other in a small bottle or flask

FIG. 1.

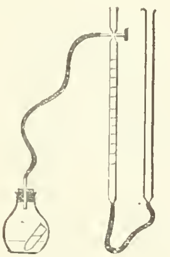

FIG. 2.

fitted with a perforated cork, and connected by narrow india-rubber tubing with the nose of the three-way tap of a nitrometer filled with brine or water (Fig. 2). A nitrometer is much better for this purpose than the device of a burette or graduated tube immersed in a tall jar of water, as is employed by Dr. Squibb and others.

* I have had a special nitrometer (Fig. 1) constructed for me for the assay of nitrous ether preparations. The graduated tube holds 50cc., and the cup is narrow and cylindrical, and has marks at 5cc. and 10cc. above the tap. This arrangement renders the use of a pipette or other separate measuring arrangement unnecessary, as the cup can be filled to the 5cc. mark with the sample, and thus a definite amount taken for the analysis. In this case a three-way tap is of no advantage. Messrs. Cubley and Preston, of High Street, Sheffield, are now prepared to supply these nitrometers to those desirous of employing the process mentioned in the text. With regard to the titration process of Mr. Dott, if the treatment with potassium iodide be effected in an open basin in presence of air, as is recommended by him, the amount of nitrite found is liable to be very seriously in error; but if air be excluded, Dott's method gives fair approximate results, somewhat in excess of the truth. The process can be advantageously employed on the solution which has already been decomposed with potassium iodide in the nitrometer. The nitric oxide is allowed to escape into the air, and the brown liquid is washed into a basin, and at once titrated with decinormal thiosulphate.

† 100 grammes of caustic soda are dissolved in 250cc. of water and 25cc. of bromine cautiously added to the well-cooled liquid. In some respects it is preferable to dilute the 10cc. of this solution with an equal measure of water before introducing it into the nitrometer.

The last arrangement is well suited for the estimation of *carbonates*, the sample being placed in the flask, and the acid for its decomposition contained in a small tube in the usual way. This amounts to a suggestion to employ a nitrometer in place of the measuring tubes of Scheibler's carbonic acid apparatus. Of course the usual corrections for solubility of the gas in the acid liquid, etc., apply as much in one case as in the other.

The nitrometer may also be very conveniently used for the assay of commercial *peroxide of hydrogen*, for which it was first employed by Mr. G. E. Davis, who filled the nitrometer with mercury and operated on 1cc. of the sample, which he agitated with 5cc. of a saturated solution of potassium bichromate. Under these circumstances Mr. Davis found the peroxide of hydrogen to be split up into water and oxygen, the bichromate remaining unchanged, and this observation has been subsequently confirmed by Mr. W. H. Symons. It is usual to express the strength of peroxide of hydrogen in terms of volumes of oxygen obtainable therefrom, and hence the nitrometer is well suited for its assay.

According to my own experience, the reaction of bichromate of potassium on peroxide of hydrogen does not occur so promptly or completely as could be wished, and I have therefore substituted for it an acidulated solution of permanganate of potassium. I prefer to operate as follows :—

The nitrometer is filled with a saturated solution of sodium or magnesium sulphate.* 1cc. of the sample is then introduced through the tap, and this is followed by a strong solution of potassium permanganate, which has been previously acidulated with sulphuric acid. The reaction occurs very promptly, and the permanent coloration of the contents of the tube suffices to show that an excess of the permanganate has been employed. When acidulated permanganate is used the reaction is as follows :—

$$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 = K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2.$$

Mr. Kingzett and these chemists have independently proved the truth of the equation by adding standard permanganate to hydrogen peroxide (in presence of free acid) contained in a Woulffe's bottle arranged so that the evolved oxygen could be collected and measured. The accuracy of the results obtained by permanganate was checked by estimating the iodine liberated by the hydroxyl from potassium iodide. Hence, when acidulated permanganate is employed for decomposing hydroxyl, only one-half of the oxygen gas liberated comes from the samples, the other half being derived from the re-agent. Therefore, 1cc. of a sample of peroxide of hydrogen, described as of "10 volumes strength," ought to give 20cc. of oxygen in the nitrometer. If an acidulated solution of potassium bichromate be substituted for the permanganate the reaction occurs very promptly, a double volume of oxygen being evolved, but for some unexplained reason the results are sensibly lower than those obtained with permanganate.

While the nitrometer is frequently used as an instrument in which to evolve and measure gas, it has not met with such a wide application as it deserves for the purpose of *absorbing* gases. But, as a matter of fact, by the aid of two of Lunge's nitrometers, having their three-way taps joined by a short piece of india-rubber tubing, we can extemporise an apparatus for gas analysis capable of a variety of applications. This is practically done by Bunte in his gas apparatus, but, curiously enough, in the method of working he prescribes, he makes little or no use of his cup, preferring to introduce his re-agents by a somewhat complicated manipulation through a tap at the bottom of the nitrometer. In Elliott's gas apparatus full use is made of the cup arrangement, but instead of employing a three-way tap, Elliott uses a special arrangement for transferring the gas to the measuring tube.

Having not unfrequently to make analyses of blast-furnace and Siemens gases for technical purposes, the importance of having a rapid and moderately accurate method of gas analysis has forced itself on my attention, with the result that I have devised a very simple apparatus, combining the various advantages of the instruments of Stead, Bunte and Elliott. The following is a description of the apparatus in its simplest form.

The measuring tube A (Fig. 3) ends at the top in a capillary tube bent at right angles, and furnished with a tap E. Two platinum wires are sealed into the upper part for passing an electric spark when required. The lower end of the tube is drawn out and attached by india-rubber to a T-piece, by which it is connected to the parallel open tube B and to the

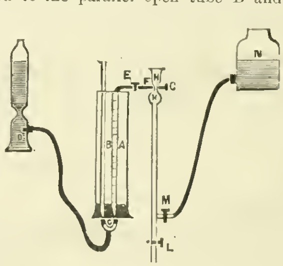

FIG. 3.

reservoir D. In cases where the apparatus is to be used with mercury, the vessel D should be replaced by a reservoir sliding in vertical grooves, and adjustible by means of a pulley. The tubes A and B are enclosed in a glass cylinder, which is filled with water, the temperature of which is usually found in practice to remain constant during the whole time required for a gas analysis. The capillary tube at the top of A is connected by a few inches of narrow india-rubber tubing with the three-way tap of a nitrometer. The nitrometer-tube I prefer to employ has a globular enlargement just below the tap, and is furnished at the bottom with two taps L and M, by the latter of which it is connected with a reservoir of water N. A Lunge's nitrometer can be used as a makeshift for the special tube shown in the diagram, clips being substituted for the taps at the bottom. The apparatus can be worked equally well with either mercury or water, but to avoid repetition, I will describe the manipulation when water is used, and assume the gas to be analysed to be a mixture CO_2, CO, CH_4, C_2H_4, O, H, and N.

Before commencing an operation the nitrometer is detached from the measuring tube, the tube E is opened and the reservoir D raised, so as to drive out the whole of the air from the measuring tube, and its capillary continuation E is then closed, the reservoir lowered, attachment made with a receptacle containing the gas to be analysed, when, on the tap E being re-opened, the gas flows into the measuring tube. E is closed and the height of the reservoir D adjusted until the water in A and B stands at the same level.

* If brine be used there is a tendency to error from the evolution of chlorine.

The measure of the gas taken for an experiment is then read off, and the temperature of the surrounding water and height of the barometer observed. As the gas only comes in contact with the water for a short time, and is not agitated with it, only a very trifling loss of CO_2 by absorption will occur, and this may be further diminished by employing strong brine instead of water. The nitrometer is now filled with water, some water being also placed in the cup, and the three-way-tap is opened so as to allow the india-rubber tube F to become filled with water, and while this is dropping connection is made with the capillary tube of the measuring vessel. The three-way-tap is then turned so as to open a communication between A and K, the tap M closed and L opened, when the gas will flow from A into K. A few drops of water from A are allowed to follow the gas. E is then closed, some of a concentrated solution of caustic potash poured into the cup, and the three-way-tap opened so as to allow the liquid to flow into the nitrometer, when L is closed. The globular enlargement at K, an arrangement for which I am indebted to Dr. A. H. Elliott, causes the solution to spread as a thin film over the surface of the glass, and insures rapid and perfect absorption of the CO_2. In this way the minimum quantity of the reagent can be employed. Practically, absorption is known to be complete by no more reagent being sucked in from the cup, and my experience shows me that the reaction is almost instantaneous. If, however, any doubt exist on this point, all the taps should be closed, and the nitrometer detached and shaken up. The tap M is then re-opened, connection again made between K and A, and the residual gas driven back to the measuring vessel, where its volume is observed, the decrease of course being due to CO_2 absorbed. The whole manipulation is extremely simple, requiring only a few minutes up to this point. For the absorption of the other gases the same series of manipulations is required, but before proceeding to the next step it is necessary to remove the potash solution from the nitrometer. E being closed this is done by turning the three-way tap so as to establish communication between H and K. M is closed and L opened, and water poured into the cup until the nitrometer is thoroughly flushed out. Then on turning the three-way tap so as to make communication between K and A, and opening E, the gas is again drawn into the nitrometer and is ready for further treatment in the following order:—

a. The CO_2 having already been absorbed by a strong solution of potash;

b. A saturated solution of bromine in bromide of potassium is introduced to absofb the hydrocarbons of the ethylene series.

c. A little potash is allowed to enter to absorb any bromine vapour, and the free oxygen is then absorbed by an alkaline solution of pyrogallic acid.

d. The nitrometer having been flushed, the carbonic oxide is absorbed by a strong solution of cuprous chloride in hydrochloric acid. The absorption occurs with great facility, and on then running in water through the tap any hydrochloric acid vapour is readily absorbed at the same time that the cuprous solution is washed out.

This completes the possibility of analysis by absorption, and hence the next step is to add oxygen to the residual gas, pass an electric spark, and note the contraction and amount of CO_2 formed in the usual way, which observations give data for calculating the proportions of hydrogen, marsh-gas, and nitrogen. The measuring tube, parallel tube, and reservoir are practically identical with Stead's arrangement. The method of introducing and using the re-agents and the employment of the globular enlargement are due to Elliott.

Of course strictly accurate results are not obtainable if water be employed in the measuring tube, but the error due to this cause may be reduced so as in many cases to be practically insignificant if brine be employed instead of water in this part of the apparatus.*

It is possible to conceive a still simpler form of apparatus by which useful rough analysis of gases might be made. This would be to dispense altogether with the separate measuring tube, and have the nitrometer graduated and furnished with platinum wires.

Perhaps there is no chemical operation more difficult to describe than that of the manipulation with an instrument for the analysis of gases, but in practice the mode of using the apparatus in question will be found exceedingly simple, and to anyone in the habit of working with gases means will readily suggest themselves for increasing the accuracy of the results. These precautions I have purposely omitted, as I have nothing new to say upon them, and my object in bringing the apparatus before the Society of Chemical Industry is to call the attention of its members to a ready means of making technical analyses of gases with a reasonable approach to accuracy, and not to attempt to replace what I may call the standard methods of gas manipulation familiar to all scientific chemists.

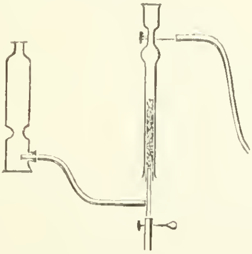

FIG. 4.

In conclusion, I may call your attention to some qualitative applications of the nitrometer with a three-way tap, which instrument furnishes an extremely ready means of obtaining certain gases in a state of purity. For instance, if the lower end of a Lunge's nitrometer tube be cut off and the opening closed with a perforated cork fitted with a T-piece, one branch of which is closed by a clip and the other communicates with the reservoir, we have a convenient apparatus for generating at will small quantities of such gases as can be readily evolved without application of heat (Fig. 4). Thus, for example, if some granulated zinc be placed in the nitrometer and the instrument filled with water, on allowing acid to enter through the cup hydrogen perfectly free from air will be evolved, and can be utilised in any manner desired by opening the three-way tap, to which a piece of india-rubber tubing has previously been attached. The T-piece at the bottom enables the dense solution of zinc to be tapped off when desired, and so the apparatus can always be kept full of hydrogen and in order for use. For small quantities of sulphuretted hydrogen the apparatus is also well

* I find that 100cc. of strong brine at the ordinary temperature dissolve 29·0 cc. of CO_2, whereas pure water would dissolve about 100cc. Messrs. Cubley & Preston are prepared to supply the apparatus for gas analysis described in the text.

adapted, and by means of the T-piece any choking up by ferrous sulphate can be wholly avoided. Carbon-dioxide also can readily be generated in the nitrometer tube, and if a small quantity of oxygen be required, as, for instance, in a gas-analysis, it can be obtained instantaneously and in a state of purity by the reaction between acidulated permanganate and peroxide of hydrogen.

It is the three-way tap which renders the nitrometer suitable for a large number of the purposes suggested.

In conducting the numerous experiments of which this paper is the outcome, I have been greatly aided by Mr. J. H. Worrall, to whom my best thanks are due.

DISCUSSION.

Professor Tilden: I think Mr. Allen is to be congratulated on the useful test he has introduced for determining the amount of nitrite in "sweet spirit of nitre," and I think pharmacists will be glad to avail themselves of it. In some earlier experiments of mine, I endeavoured to make use of the well-known decomposition of urea by nitrous acid, which results in the evolution of the whole of the nitrogen of the nitrite together with the nitrogen and carbonic acid from the urea. The relatively large volume of gas thus obtained makes the estimation of small quantities of nitrite possible, and increases the accuracy of the determinations. I venture to suggest to Mr. Allen that he should try this re-action. I feel tempted to criticise the process of gas analysis we have just seen illustrated, but I presume it is not expected to yield accurate results, and would be used only for technical and comparatively rough purposes. Its most serious defect appears to be the very large bulk of the liquid re-agents which is used.

Mr. Staveley: I should like to ask Mr. Allen if he has had any experience in the determination of the benzene present in illuminating gas. This has now become a very important point in the gas industry, and especially in the industries which have recently been started for the obtaining of benzene as the principal product in carbonising coal. There have only been two or three analyses of coal gas published in which benzene has been given. One was by Bunsen, and he gave about 1·33, and the other by Berthollet, of Paris gas, in which he gave a very large quantity, amounting to 3½ or 4 per cent. of benzene. It is very desirable that we should have an exact method of determining this. I believe the method Bunsen followed was to absorb the paraffins by bromine water, and the benzene by fuming sulphuric acid.

REPLY.

In reply, Mr Allen said: With regard to the estimation of urea, the production of the apparatus just shown was an illustration of the remark with which I commenced my paper—namely, that various modifications of the nitrometer had doubtless suggested themselves to individual chemists. I have tried the re-action suggested by Dr. Tilden, for the assay of nitrites by treatment with urea, but certainly did not obtain encouraging results, the re-action being too slow. This, however, may have been due to my using an insufficient quantity of acid. But the fact that the gas evolved would be a mixture of nitrogen and carbonic acid, would, in my opinion, be a disadvantage, as it would always necessitate operating over mercury, and hence would do away with the advantages obtained by substituting brine. Respecting the remarks of Dr. Tilden, as to the loss of soluble gases in working the gas apparatus, I may point out that agitation, under the conditions described, enables one to use the minimum quantity of each re-agent requisite for complete absorption. Literally, to effect the same set of absorptions with Stead's arrangement, the gas would have to be brought in contact with not less than 300 or 400 centimetres of liquid. Unless, therefore, we revert to Bunsen's method of absorption by solid re-agents, the mode of manipulation described by me seems the most free from objection. With regard to the question about the estimation of benzene in coal-gas, I am sorry I am unable to give a definite reply, but would suggest that some method, based on the absorption of benzene and its homologues by fuming nitric acid, would probably be found to answer

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A meeting of this Section was held in the Rooms, 207, Bath Street, on Tuesday, 3rd March, 1885.

PROFESSOR FERGUSON IN THE CHAIR.

ON THE PROCESSES EMPLOYED IN ITALY FOR THE EXTRACTION OF OILS, ETC., FROM BITUMINOUS ROCKS IN THAT COUNTRY.

BY MR. JAMES MURRIE.

Italian Bituminous Deposits.—The Italians, during the past generation, have, as you are no doubt aware, been making strenuous exertions to develop their internal resources and to occupy a prominent position in the commercial world. So far they have made a most rapid advance in manufacturing for their own requirements, and the public and commercial undertakings initiated and carried out during this period will compare favourably with the advancement made by any other civilised nation.

These results are mainly due to the enlightened and far-seeing legislation of their Government, which, while aiming at making Italy one of the most tolerant and free countries in the world, have held out every inducement and facility to foreigners to embark in their undertakings, or to initiate and develop industries under the surveillance and direction of their own employés, irrespective of nationality. Hence a very great proportion of the works carried

on have been begun and conducted by imported skill and capital; and it may be added that it has been the heavy taxation on this same capital which has been mainly instrumental in placing Italy in its present sound financial position.

Unfortunately for the continued prosperity of the country, it lacks one of the most important agents by which its almost illimitable mineral wealth can be made the most of—namely, a coal-bed. Although possessed of a considerable number of carbonaceous deposits, mainly in the form of lignites, these are either too poor in heating properties, or too limited in quantity to compete with imported sea coal, the cost of which is a heavy tax on the finished products of manufacture. The Italian Government, fully alive to the importance of having reliable data on the various mining operations carried on, have established a corps of engineers, having headquarters in the principal centres, whose duty it is to examine and report on any new bed of mineral, and to give an abstract of the processes in operation. The result is embodied in an annual report, which is published in book form and contains a fairly accurate synopsis of the work done and in progress. To those interested in this department of Italian industry the report in question forms an excellent reference.

Apart from this, there are a considerable number of foreign adventurers or explorers in the country, who are keenly alive to the value of any discovery of any new field of mineral capable of being turned to account commercially, and who, in a majority of cases, are the promoters or indirect means of floating new concerns, in connection with which it cannot be too well known that the country has been explored throughout by Government experts, and, besides, is peopled by a class who know the value of commercial commodities as well as the passing or temporary resident. Any reported discovery cannot therefore be too well scrutinised, even although backed up by scientific reports.

Oil and bituminous indications do occur over a very wide area at different points throughout the country, which have received more or less attention from those interested, and which has given rise to the popular belief that a belt of oil passes through the Appennines in the direction of Roumania, rising to the surface near Bucharest. This theory has received the support of several British geological experts, which, if true, and capable of being extracted on the American system, would undoubtedly prove a great stimulus to Italian industry, and be the means of making Italy the leading nation in the Mediterranean.

The oil and bituminous indications which have received the greatest share of attention are those found in a spur of the Appennines, known as the Abruzzo, in the province of Chieti, and about twenty miles inland from the town of Pescara, on the Adriatic. The locality can be determined by a reference to a map: an imaginary line, drawn between Mount Etna in Sicily and Mount Vesuvius at Naples, and continued towards the Adriatic, will pass through the district in question, the exact locality being about 90 kilometres beyond Naples.

The oil indications occur in the form of a flux, or tarry, sandy mass, which exudes from the mountain side after heavy rains, and the bituminous indications in the form of asphaltic rock. The asphaltic deposit I purpose describing more particularly, occurs in the slope of the mountain, dipping into the southern side of the river Pescara, in the vicinity of the town of San Valentino. The minerals of the district consist of broken limestone, sandstone, marl, and clay, gypsum and limestone with indications of sulphur, and the geological formation appertains to the eocene age. The bituminous rocks occur in two distinct forms—namely, a strictly asphaltic rock, consisting of limestone and earthy matter impregnated with bitumen, the bitumen acting as a cement in holding the body together; a bituminous stone resembling the American prairie oil-stone in appearance, the rock in this case acting as a carrier of the bitumen.

The asphaltic rock is formed on the lower slope of the mountain, rarely at a greater altitude than 2000ft., and the oil-stone, or bituminous stone, invariably at a greater altitude. The asphaltic rock is strictly a superficial deposit, which occurs very irregularly, sometimes in isolated boulders of limestone, but more frequently in surface soil or thin sheets of nearly pure bitumen between the earthy soil and a lower bed of clay. In the case of limestone, the rock usually resembles a foliated clay, or rottenstone, cemented together by the bitumen, and in a few instances, nearly pure limestone uniformly saturated with the bitumen, the proportion rarely exceeding eleven per cent., and the average about five per cent.

The bituminous stone found at a higher altitude is more uniform in its nature, consisting of calcium and quartz, closely associated with each other, filled with myriads of microscopic cavities, which contain the bitumen. This deposit occurs in veins running parallel with one another in line with the slope of the mountain; the breadth of the vein is very variable, in some cases 10ft., and in others—not one mile apart—100ft. The depth averages 60ft. The proportion of bitumen is more uniform than in the lower deposit, the average being three and a half per cent.

Manufacture of Products from Asphaltic Rock.—The asphaltic rock is, from its peculiar formation, specially adapted for asphaltic purposes; as such it has been fairly successful, and through the instrumentality of an Ancona merchant, W. von Bremen, has found its way to nearly every part of the globe. The process employed in its preparation corresponds to the kindred operation carried on in the neighbourhood in the preparation of mastic for pavements. The Italian process is essentially as follows:—The rock on being quarried or excavated is conveyed to the factory by means of donkeys, mules, and women, thence is broken up into pieces suitable for passing through the disintegrator or pulveriser, converting the stone into a powder the consistency of finely ground sand, in which condition it flows into a revolving cauldron, maintained at a constant temperature of 400° F., and is there mixed with a proportion of bitumen, the percentage depending on the quality of the rock, and the purpose to which it is to be adapted. For flooring and roofing purposes about 6% is usually added.

After the mixture has been thoroughly agitated, the semi-viscid mass is run into moulds, not unlike a cheese box; on cooling it hardens sufficiently to admit of handling in railway transit, when on reaching its destination and being prepared for use, it is again broken up, re-melted in small boilers, and spread over the flooring or pavement bed, trowel fashion.

It forms a capital roofing material for a warm country; being a good non-conductor, it keeps the chambers cool and refreshing in summer, and effectually excludes moisture from entering in winter. For flooring, again, it prevents damp, and being hard enough at the ordinary temperature to resist abrasion, answers well for many purposes where a clean and dry floor is an important consideration. Its employment as a pavement and cement for reservoirs and canals is too well known to need repetition. In manufacturing paving bricks, the semi-liquid

powder run from the revolving cauldron is conveyed to a hydraulic press, fitted with a series of recesses and dies to stamp the brick into the desired shape; the recesses are made to contain five or six times the capacity of the finished brick, a pressure of about two tons per square inch, applied gradually, being sufficient to give the brick the necessary degree of hardness. A pavement formed of these blocks, made of a neat pattern, say having hexagonal faces, about 6in. in diameter, and about 2½in. thick, presents an exceedingly attractive and artistic appearance, and at the same time excels any other in durability and cleanness. The high cost of manufacture and heavy transport charge has prevented the introduction of these bricks on any large scale, although often met with in the courtyards of the more important Continental cities, particularly Venice, Rome, Florence and Paris. The moist atmosphere of London has prevented its introduction to any extent in that city. has proved so to several companies who have erected plant with the expectations of extracting the bitumen on the same line as employed elsewhere. This becomes apparent when we consider that to heat the asphaltic rock means melting the cementing or adhesive body; the earthy matter or broken limestone having no longer any tendency to retain its rigidity crumbles up and subsides to the lower part of the vessel, forming a semi-viscid mass of bitumen, soil and gritty limestone, which can neither be strained or separated by mechanical means. While this tendency or action is serviceable in the preparation of mastic, it renders the rock practically useless for the extraction of bitumen.

The only material suited for the extraction of bitumen is the stone found at the higher altitudes, which, depending on the cementing property of the lime to retain its rigidity, can be heated to a comparatively high temperature without disintegrating

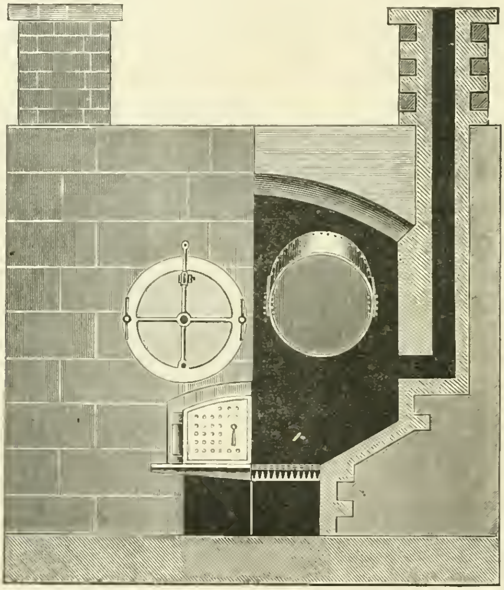


FIG. 1.

It may be added that the odour given off in melting and laying bituminous mastic is rather agreeable than otherwise, and forms a striking contrast to the coal-tar asphalte paving operations carried on in this country.

EXTRACTION OF BITUMEN.—Closely associated with the preparation of the mastic and forming a companion to it, is the extraction of the bitumen from the rock, either for mixing subsequently with the asphaltic powder already described or for other purposes. The process at first sight seems to be a very simple one, the mineral only having to be heated in a suitable vessel to allow the bitumen to liquefy when heated, and descend or flow downwards through the mineral, escaping by a suitable outlet placed in the lowest part of the chamber. In reality, however, the operation is comparatively difficult, and The effect of heat on this stone—say, 300° F.—leads to the bitumen liquefying and exuding from the minute chambers or cavities in the form of a heavy liquid, having a jet black lustre, which on cooling solidifies to the consistency of solid pitch. A higher heat—say 400° F.—converts part of the bitumen into a semi-oil or tar, and at a still higher temperature decomposition begins.

Several retorts have been devised for extracting the bitumen from the asphaltic rock and bituminous stone; those for treating the former, it may be stated, have been failures, and need not therefore be described; those retorts, again, which have been devised for treating the hard stone have given more or less satisfaction. The most common form is that shown in Fig. 1 and 1A, which essentially consists of wrought-iron cylinders about 7 feet long by 30in. internal

diameter, closed at one end, and placed in an oven with the open end slanting downwards, the angle being just sufficient to allow the bitumen to flow towards the exit formed in the door. Two of these retorts are generally placed in one oven, and several ovens in one bench. The fuel employed is the inferior quality of rock, and the quantity consumed in the furnaces averages one half the quantity treated in the retorts. Each retort contains about 14cwt. of rock, previously broken into pieces the size of a common brick, and the time taken for each charge averages six hours. This form of retort answers fairly well for the bituminous stone, but has failed in extracting bitumen from the asphaltic rock, due to the gritty matters subsiding to the bottom of the retort and forming a barrier to the outward flow of the liquid, which at the same time prevents the heat from penetrating to the interior, a higher heat to effect this causing the formation of a scale, which rapidly leads to the destruction of the retort.

A better designed retort is that of Mons. Boutigny, shown in Fig. 2, which was awarded a silver medal at the Paris Exhibition. The retort is built in an oven, vertically, its main characteristics being the arrangement for preserving the interior of the retort at a uniform temperature; this is accomplished by having an inner vessel, resembling the shell of the retort, but small enough to fit inside, a space being left between the outside of the inner vessel and the inside of the outer shell, to permit a circulation of vapours in the annular space.

The inner vessel contains the rock to be treated, and having its sides perforated, allows any vapours generated to pass into the annular space referred to, and circulating between the two walls, tends to prevent unequal heating. The bitumen is collected at the bottom by a receiver resting on a trolly, and the spent rock subsequently tipped into a small wagon and removed to the furnace by an inclined railway, sufficient carbonaceous matter remaining in the rock to admit of its utilisation in heating the retorts. The average working temperature is 350° F., and the time taken to treat one charge about four hours. The bitumen obtained working with this form of retort is more pure and contains a less percentage of water than any other, and the labour in charging and firing is greatly reduced by the mechanical devices employed.

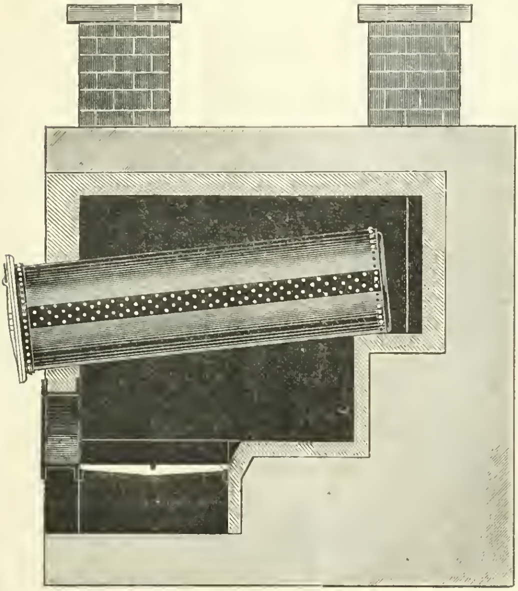


Fig 1A.

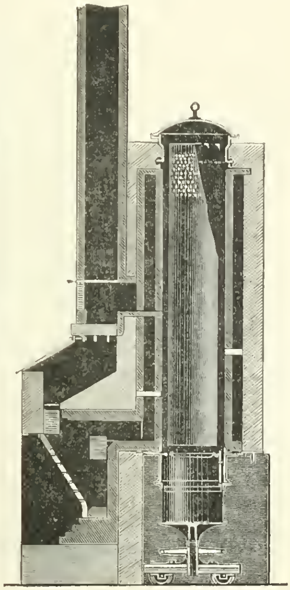


Fig. 2.

Oils.—In nearly all cases the companies floated to work this mineral have made the extraction of oil their main point, the heavy duty on imported petroleum, and the great annual consumption of oils for lighting purposes, proving a great attraction in a prospectus. Invariably, or nearly so, these reports begin as to the magnitude of the deposit, citing some well-known geological expert as the authority, who, making a flying visit through the valley, has allowed his imagination to outweigh his judgment; further, the ease with which the mineral can be treated, the heavy proportion of beautiful burning oil, and, finally, the immense profits to be made under the invariable judicious management.

The number of companies who have actually erected plant to extract oil from the rock are numerous, and the amount of money sunk in the ventures simply incredible, and with but one issue—total failure and loss of the capital.

The operations have usually been commenced by an attempt to distil the oil from the rock direct in horizontal retorts, in the same way as the Scotch shale before the introduction of the verticals. The result has been failure, which will be evident from

what has been said about extracting the bitumen, the tendency to form a scale in the retort being greatly intensified, which, no matter how carefully fired, rapidly leads to the destruction of the retort, while the quantity of oil obtained after one or two charges dwindled down to about one gallon per ton. The next process has been to extract the bitumen, and subsequently distil it in oil stills, which also has proved a costly process, the bitumen containing a large proportion of water and foreign matter, rendering its distillation by ordinary means a tedious operation and a failure financially; the intermediate process adopted in this country by settling the bitumen and allowing the heavier bodies to subside, being inapplicable, owing to the ebullition of the bitumen at the temperature necessary to ensure precipitation.

ultimate success was that initiated by the late Mr. William MacIvor—long connected with Young's Company at Bathgate—which consisted in distilling the oil from the rock direct by means of superheated steam applied internally.

Mr. MacIvor, who had been appointed by a local company, some ten years previously in existence, to examine into their mineral and report on the best means of extracting marketable products therefrom, after making a number of experiments in extracting oil and bitumen, decided on trying the effect of passing a heated gas through a charge of rock in a small vertical retort, the gas being maintained at the temperature necessary to ensure distillation. The result showed that by employing steam superheated to a temperature of about 600° Fahr., a yield of about 15 gallons per ton could be obtained in about ten hours' time; the retort containing about 14cwt. of mineral. On this basis plant was erected to treat about 200 tons of rock per week, consisting of six vertical retorts having a capacity of about three tons each. The general arrangement is shown in Fig. 3. Each retort had a superheater—Bennie's 2in. size—and the steam was generated in a steam boiler 14ft. long by 7ft. 6in. in diameter, multitubular type. The condenser consisted of the old style of verticals. Mr. MacIvor unfortunately did not live to see his process carried into practice, and on this account it may not have received justice. Working the full bench of retorts, the yield did not exceed five gallons per ton, further workings showing that a fixed volume of superheated steam, at a temperature of about 600° Fahr., was necessary to ensure distillation of the oil. With the boiler working at its full power, the best result obtained was 12 gallons per ton, with three retorts at work, and the time taken for each charge,

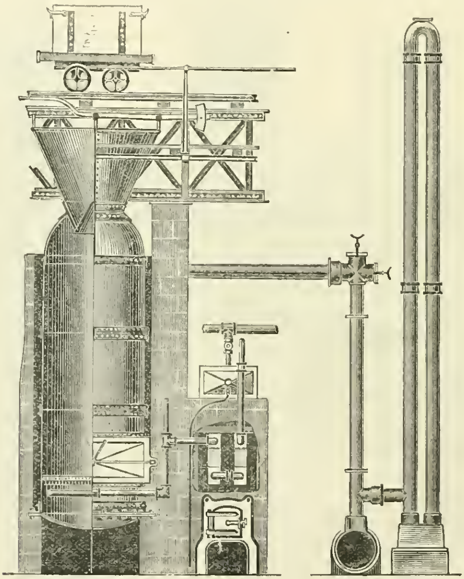


FIG. 3.

The first attempt made to treat the mineral by means of a vertical retort, with the view of extracting oil direct, was initiated by the late Mr. George Bennie, the special retort designed to treat the mineral consisting of an arrangement analogous to the "Boutigny" bitumen retort, the inner vessel being replaced by vertical bars in the form of a wicker basket. The vapours were led off from the top of the retort and condensed in a horizontal condenser. Four retorts were placed in one oven, and the time taken to distil one charge of rock averaged eight hours. This retort, although well adapted for some qualities of the minerals, did not answer for the asphaltic rock, the bars after several months' operations requiring renewal.

Several other forms of retorts were introduced, which, after trial, were discarded; there is no feature of novelty in their design which merits description.

The only process attempted with any prospect of

twelve hours. The process so far was a total failure financially. The rock to begin with cost about 10s. per ton for mining and transport, and fuel over 20s. per ton for each ton of mineral treated, thus saddling the crude oil with a first charge of over 2s. 6d. per gallon, the market value of which was under 1s. per gallon. The process, while capable of great modifications, possessed several features which greatly added to the cost of operations, only a very small proportion of the heat in the steam was utilised, the greater proportion escaping in the form of latent heat, which again required a great volume of water to ensure condensation. Loss also occurred in the retort through having to raise the temperature of the rock to distilling point before any oil vapour could escape, the action in the retort consisting of a series of condensations and distillations.

At this stage an attempt was made to simplify the condensing arrangement by simply lowering the temperature of the steam issuing from the outlet pipe sufficiently to precipitate or condense the oil vapour without condensing the steam ; close observation showed that the steam, at a temperature of about 300° F., contained only an infinitesimal quantity of oil vapour, clearly proving that the mineral contained no light oils. A second modification was made by enclosing the retort in a jacket formed of bricks, the waste gases from the superheaters winding round the retort before entering the flues. This alteration had the effect of reducing the time of distillation to about eight hours, the full percentage of oil in the rock being obtained, the latter presenting the appearance of having been bleached, and without any bituminous taint. The volume of steam necessary was also, in consequence, reduced about one-third, and the purity of the crude oil superior to that hitherto obtained. Further modifications were brought to a termination through the discovery, at this time, that the company who were carrying on the operations had no more asphaltic rock in their mines, the extent of which was supposed to be so great as to induce the company in question to expend from £50,000 to £80,000 in preparing to begin operations.

This led to a more close examination of the formation of the deposit, the result of which is embodied in the views given further on. The bituminous-stone in the higher grounds was tested with the result that two benches of retorts were erected to extract the bitumen, which was subsequently distilled in the ordinary oil stills, the operation being greatly facilitated by adding a proportion of light oil to the bitumen in the still ; this had the effect of cutting up or dissolving the semi-solid mass very rapidly when heated, and thereby allowed the water vapour to ascend freely to the surface, and escape without causing frothing or boiling over.

The oil obtained from the distillation of the bitumen differs greatly in its properties from any other known oil, its most marked characteristics being its unusual density, its freedom from ammonia, scale and spirit, or light oils.

One thousand parts of bitumen distilled and rectified

Yielded.	Sp. gr.	Per cent.	Flash-point.
Burning Oil	·850°	150	130°F.
Intermediate	·945	330	250
Lubricating	·990	165	315

The oil obtained from the rock direct, by the superheated steam process, had a density of about ·985, 1000 parts of which yielded when distilled and rectified—

Oil under sp. gr.	·900	50 parts.
Oil sp. gr.	·915	150 „
Intermediate sp. gr.	·945	300 „
Lubricating sp. gr.	·995	155 „

There are no bye-products. An attempt was made, with fair success, to convert the spent rock into lime, the plan adopted consisting in storing the rock when just drawn from the retort in a mound, and allowed to burn. The residue consisted of a very pure lime, but tainted with a bituminous odour.

So far as the manufacture of oil is concerned, the duty on imported petroleum will never influence the production of burning oil from this asphaltic rock. The density is too great to enable its being employed in petroleum lamps ; the heavy percentage of sulphur compounds present also materially adds to the cost of refining, while its complete removal is hardly possible even with careful treatment. The only use to which it can be applied is in street lighting or lighthouse purposes, where special burners can be introduced for supplying the necessary quantity of air to ensure construction. Its high flash-point is one recommendation which is more than counterbalanced by the preponderating disadvantages. The intermediate oil is only adapted for cleaning and mixing purposes, its body being equal to the Scotch ·803 intermediate.

The lubricating oil makes a splendid lubricant when mixed with a percentage of vegetable or fatty oils ; its high density is not an index of its viscosity, the final distillate has a body several times greater than the finest shale oil, but it loses this property very rapidly on being heated, at least in a much greater ratio than in any other known lubricant. It thus demolishes the old saying met with in treatises and pamphlets on oils, that the density of a mineral oil is a safe criterion of its viscosity.

Origin.—It becomes an interesting point to deduce from the formation of this mineral data to enable some notion being formed of its probable origin, and the bearing it has on the supposed oil belt theory.

It is self-evident that a relation exists between the deposits of bituminous rock which have been described under the term of "asphaltic rock," and the harder material under "bituminous stone." The lower deposit, I believe, has simply been formed through the overflow of oil through a higher level ; its association with limestone can be accounted for when we consider the effect of an acid in solution on calcium carbonate ; the fact of clay forming a break in the downward descent of the oil, likewise shows that the solution has been diverted or prevented from penetrating through non-absorbing material.

The deposit also being superficial and in general mixed with broken limestone and boulders, demonstrates that the latter have found their way from a higher level at a period antecedent to the oil overflow. Then if the stone found at the higher altitudes be closely examined, some other way must account for its formation. The presence of quartz, and the lime being the binding agent, would show that the bitumen has been deposited or secreted in the minute cavities by some other agency than downward percolation. I am inclined to account for its origin by assuming that the vein at one time formed a natural depression in the mountain side, which had become partially silted up afterwards through some subteranean agency ; the mountain was subjected to heat, this heat acted on a bed of lignite, other carbonaceous material causing a distillation, the vapours in ascending found vent in this depression, the heavier vapours partially condensing, and the more volatile vapours escaping. It is possible, of course, that the heat acted on a reservior of oil, perhaps the vein or belt of oil now believed to exist or pass through this identical spot ; but to strengthen the supposition that it was a solid carbonaceous body, a layer or bed of lignite crops out of the mountain about twenty miles distant, and it is of course possible to have been a

continuation of the same strata. Even with oil, there seems to me to be no more rational way of accounting for its presence than by assuming that a vast bed of carbonaceous material imbedded in the earth was subjected to heat, which causing contraction, would leave a space for the storage of oil and vapour, the rigidity of the earth at the depth preventing subsidence.

In any case, unless the distilling action is still going on, the oil must, through long ages, have become reduced or exhausted; only a very small proportion could have been caught by the surface soil, the greater volume would find its way into the rivers, and thence to the Adriatic. A close examination of the river banks confirmed this view, and showed also that the period of the overflow was comparatively limited, the indications being confined to one line or strip in the sides of the channel. To still further confirm this supposition, Cicero, in one of his histories, mentions, as a wonder or curiosity of the age, that the river Aternus flowed with blood. The Aternus here spoken of is the same river which flows through the valley to the Adriatic, known now as the river Pescara, and it is very probable that what was supposed to be blood, was really the oil on its way to the sea.

There is evidence in the local archives that oil was sent from the district to Rome, Venice, Turin and Milan for several centuries back. The oil being utilised for street lighting purposes, and the bitumen as a cement for water cisterns. But whether the oil was then distilled from the bitumen or consisted of the natural tar which exuded from the mountain side after heavy rains, is a point I failed to find out.

The indications of oil throughout the country bear a strong resemblance to each other in the low proportion of burning oil and the similarity in properties.

No stronger indications exist in the country than those at the opposite angle of the depression, or basin, about seven miles distant, near a village named Socco Casauria. At the present day a heavy black oil—sp. gr. ·950—exudes from the mountain-sides after heavy rains, corresponding in its properties to the oil obtained from the asphaltic rock. Several attempts have been made to strike oil at this spot and in its vicinity, a great impetus having been given to speculation in this direction after the American oil wells were established. In 1863, an Italian gentleman, Maurizio Laschi by name, began operations on a small scale, and ultimately formed a French-Italian company, who erected a refinery and made four trial borings at two different points in the mountain-side, close to the outflow of oil. One well was sunk 1550 feet, a second 540 feet, and the third and fourth about 900 feet each. Oil was obtained at different levels, but in comparatively small quantity, and insufficient to cover working expenses. The operations were conducted by a company of Canadian borers under the direction of an Italian engineer, named Euphemio Ribighini. The altidude of the ground where the borings were made was about 1520 feet above sea level, so that they penetrated about 30 feet beneath the sea line. The following is the result of one distillation of the oil:—

1000 parts sp. gr. ·951;	
Oil	= 635
Water	= 29
Residuum	= 322
Gas	11

The once run oil on being redistilled and refined gave the following fractionations:—

Boiling Point.	Proportion.	Sp. Gr. 60° F.	F P	Notes.
Under 350° F.	·0053	·78	900°	Clear.
„ 400	·0079	·79	123	—
„ 410	·0101	·80	150	—
„ 430	·0062	·81	177	—
„ 445	·0078	·815	183	Pale Yellow.
„ 465	·0047	·82	203	—
„ 480	·0072	·83	214	—
„ 500	·0063	·84	223	Yellow.
„ 520	·0062	·85	246	—
„ 570	·0098	·865	273	—
Over 570	·0098	·875	281	Grease.
„ 570	·0053	·890	320	
Residuum.	·0088	—	—	Solid.

The result of this spirited attempt to tap the supposed oil belt was a total failure; the pumps were kept at work for about 18 months, each being wrought in rotation to allow the remainder to recuperate; even then the quantity of oil obtained barely covered cost of fuel and attendants' wages.

The oil was refined and employed in specially constructed lamps for street lighting, the sulphur compounds having been previously partially removed by a treatment with acetate of lead, and subsequent prolonged heating in presence of caustic soda. Oil has also been found at other points in the country, particularly in Veghero, near Rivanazzano. The oil corresponds in its properties to that already mentioned, the density being a shade less, but the odour much more disagreeable, due to the presence of sulphuretted hydrogen. The density of the oil at 60° F. is ·915, and the result of treating 1000 parts is as follows:—

Boiling Point.	Proportion.	Density.	F. P.	Notes.
220° F.	100	·875	65° F.	Strong Odour.
230	70	·88	75	Clear.
240	99	·89	85	„
250	93	·895	98	„
260	107	·90	108	„
270	81	·92	114	Yellow Tinge.
280	118	·925	117	Yellow.
310	121	·93	145	„
Above 310	92	·945	156	Dark Yellow.
Do.	53	·95	175	Grease.
Residuum.	64	·971	200	Solid.

In concluding, it seems to me that further attempts at boring for oil will prove both fruitless and unremunerative. Oil may have existed in quantity at one time; but all the evidence points to the fact that it has been dissipated or dispersed, and it is the remains of the past extensive distillations which is now scattered over the country.

DISCUSSION.

Mr. HENDERSON: I understand that Mr. Murrie attributes the formation of these bituminous deposits to what is really a case of natural destructive distillation of a bed of lignite. Have any traces of such a bed been discovered, or do the rocks in the neighbourhood of the deposit appear to have been subjected to such heating or metamorphism as would be necessary to produce this alteration in the lignite?

Mr. MURRIE: There is no superficial evidence of the rocks having been subjected to heat at a period corresponding to the time of the supposed oil distillation or overflow. A packet of calcined clay was found in one of the veins of bituminous stone at an altitude of 2800 feet; but its presence could be accounted for in another way. Had it been possible to excavate the vein of bituminous stone to a sufficient depth, I believe evidence would have been obtained to determine with certainty the cause of the bituminous deposit. The bed of lignite, which cropped out in the same range, but about 20 miles distant, probably passed through the district; but the accumulation of *débris* from higher ground hid from view indications of this and other strata, which would, perhaps, have aided in arriving at more definite conclusions. I understand Sigr. Laschi, already referred to, started a factory in the vicinity of Civita-Vecchia, with the view of extracting oils from the lignite found in that district; but I do not know with what results. The oil obtained from the beds of lignite on the Mediterranean side is too dense to be of value in competing with petroleum; it is used for gas-making purposes, and mixing with American petroleum, for street lighting, where special lamps are employed. The more dense oil is refined and mixed with animal and vegetable oils for lubricating purposes, but on a very small scale.

DESCRIPTION OF A SERIES OF NEW OR IMPROVED THERMOMETERS FOR TAKING HIGH TEMPERATURES.

BY MR. JAMES MURRIE.

AT the January meeting, time did not permit my explaining more fully the principles embodied in these new temperature indicators, and the various details of their construction.

The metal mercury, for well-known reasons, has been universally adopted as the best means of obtaining indications of variations of temperature, within certain limits—viz., the freezing and boiling points of the liquid. The freezing point does not require to be considered in this case; and the boiling point under atmospheric pressure is allowed to be 662° F., and near 600° in a vacuum. In the construction of an instrument such as the common mercurial thermometer, it is invariably the custom to exclude atmospheric air from the inner part of the instrument, the space reserved in the stem for the expansion of the mercury being a vaccuum, or nearly so. The upward limit of the range of the indicator is thus between 600 and 662° F., depending on the length of the stem, and one or two minor conditions. It is evident that the higher boiling point of the mercury under atmospheric pressure is due to the increased resistance to ebullition; and, reasoning from this, it is evident that by still further increasing the resistance, a greater range of thermometric readings can be obtained. On this principle depends the action of the more important of these heat indicators, virtually being an extension of the ordinary mercurial thermometer.

The most simple means of increasing the resistance to ebullition is obviously the utilisation of the great density of the liquid, in having a vertical column sufficiently long to give the desired pressure on the mercury in the bulb. Another, and perhaps not more difficult way, while it has the advantage of dispensing with the long stem, is in having an elastic fluid, such as nitrogen, in the confined space above the mercury, either in the form of a bulb or elongated chamber, the quantity of the fluid being just sufficient to resist the expansive action of the mercury, and thereby generate an opposite pressure, which is the direct means of raising the boiling point. The glass would, of course, not be adapted for comparatively high temperatures, although suited, if the thermometer be carefully constructed, to indicate temperatures to 750° F. The instrument I have had in use for nearly two months, indicated to 728°, and so far shows no sign of alteration.

For higher temperatures glass would either have to be discarded or some means taken to preserve the

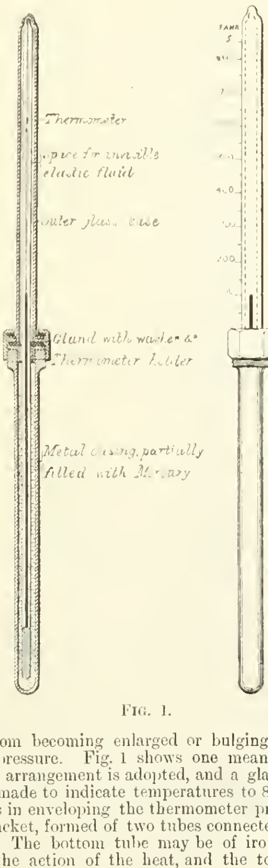


FIG. 1.

bulb from becoming enlarged or bulging outwards under pressure. Fig. 1 shows one means whereby such an arrangement is adopted, and a glass thermometer, made to indicate temperatures to 850° F. It consists in enveloping the thermometer proper in an outer jacket, formed of two tubes connected near the centre. The bottom tube may be of iron to withstand the action of the heat, and the top tube of glass to enable the movements of the mercury in the inner stem being seen. The annular space is filled

with mercury in the bottom part, and a neutral elastic fluid in the top of the chamber, which is in communication with the thermometer stem. The mercury in the annular space on being heated expands, compresses the elastic fluid in the top part, and at the same time creates an internal pressure equal to and corresponding to the pressure tending to cause distortion, or in other words the outward and inward pressures being equal there is no tendency to alter the form of the central thermometer. The glass is maintained in position by a fluted washer, made to embrace the body of the stem. This plan may be applied to the ordinary thermometers, thereby removing the complaint about the zero point not remaining constant, when the instrument was in constant contact with the heated body.

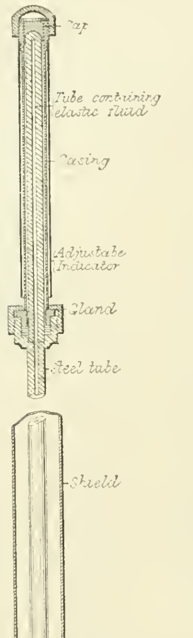


Fig. 2.

For temperatures above 850° F., it is preferable having the bulb made of iron or steel, as shown in Fig. 2, designed to indicate temperatures up to 1000° F. This instrument is but a modification of the one described at the January meeting, the elastic fluid in this case being nitrogen. The indicator tube containing the elastic fluid has a fixed relation to the capacity of the bulb, the aim being to generate sufficient pressure to prevent ebullition without unnecessary strain on the apparatus. By arranging the bore of the tube to contain the necessary volume, and having a clear daylight of 11in., each inch exactly corresponds to a range of 100° F., the temperature at 1000° F. corresponding to 10in. on the glass. The bulb is protected from distortion by an arrangement analogous to the more delicate instrument shown on Fig. 1. In this case the bulb alone is jacketed, the annular space being partially filled with mercury, the saturated vapour of which gives the pressure corresponding to that in the minor bulb. The inner or bulb proper is thus free from all tendency to distortion. This form of instrument has been most

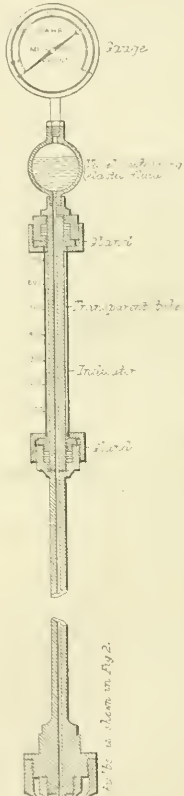


Fig. 3.

severely tested to ascertain the effect of heat and mercury combined on the bulb, and so far has given satisfaction. There are a variety of modifications of this form which do not require special notice, some of which will at once occur to you, such as employing the saturated vapour of ammonia or carbonic acid in the upper chamber. The foregoing apparatus are mainly intended to take indications of temperature with comparative rapidity. The mercury only having to absorb a specific quantity of heat, no time is taken up in generating vapour.

Where the instrument is a fixture, as in the ease of an oil still, a rapid indication is of less importance, the temperature of the gases in the vessel taking some time to vary, allows the apparatus time to accommodate itself to the new conditions. In such cases the apparatus may be constructed in a slightly different way. The mercury may be maintained in a liquid

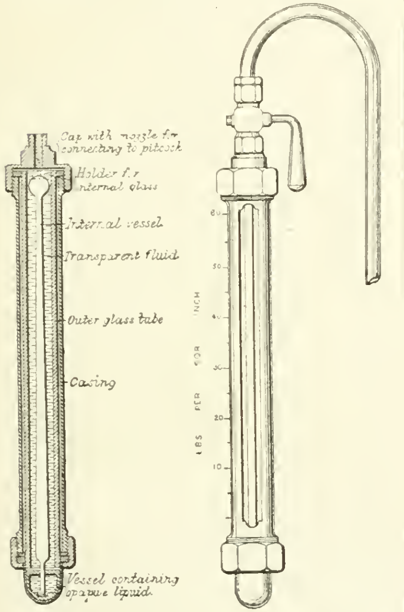


Fig. 4.

condition by the pressure of its own vapour, generated in and confined to the bulb, this pressure being measured by a pressure gauge. The arrangement is really based on the same principle as Schaeffer's Tension Thermometer, only the means of carrying out the principle differ very materially. Here it is the bulb alone which is heated, or brought in contact with the heated body. Any vapour generated cannot escape from the bulb, the pressure of which is communicated to the gauge by a column filled with mercury. This arrangement is shown in Fig. 5.

Fig. 3, it may be added, is a combination of the two principles, the expansion of the mercury being shown by a transparent glass tube forming a continuation of the stem, and the pressure of the saturated vapour measured by a Bourdon or own form of gauge. In determining the pressures of the different vapours, it became evident that some other gauge than the Bourdon would have to be adopted if accurate indications were to be obtained. The spring of the gauge when subjected to a comparatively low heat, either lost its elasticity or the expansion of the spring was magnified through the rack and pinion arrangement. For indicating pressures in steam boilers, the Bourdon may be fairly accurate, but it is not adapted for laboratory work, where extreme accuracy is essential. The sketch (Fig. 4) shows a pressure gauge designed as an adjunct to the thermometers, and

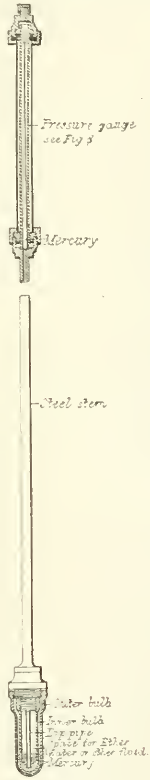


Fig. 5.

Fig. 6.

which promises to compete with any metal spring gauge, having the advantage in cost, accuracy and sensitiveness. It consists of a glass tube sealed at one end, and having its terminal widely separated by the device of employing a bulb on the extremity of the tube. This tube is filled with an elastic fluid, and its open end dipping into a vessel filled with an opaque liquid. Surrounding this central vessel is an outer chamber, and the annular space filled with a transparent liquid. The instrument on being connected to the generator, and the valve opened has its contents subjected to hydrostatic pressure, which compresses the elastic fluid in the central vessel to the extent shown by the ascent of the opaque liquid, the pressure existing in the generator being shown by an indicator

D

fixed on the outer casing of the gauge. In practice the instrument has answered well for high pressures, and it has been and is being fitted on steam boilers with satisfactory results.

Figs. 5 and 6 illustrate this form of instrument, with one of these pressure-gauges attached. The bulb can be filled with any fluid which will not act on the mercury or metal forming the bulb, and the pressure of the saturated vapour measured by any known gauge, due allowance being made for the pressure caused by the column of mercury in the stem. Working with mercury alone, temperatures ranging to 1400° F. can be indicated.

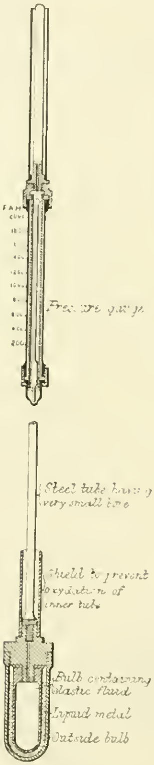


Fig. 7.

Another form of apparatus, specially designed for temperatures approaching 2500° F., is that shown in Fig. 7, which is practically a gas thermometer, but possessing one or two features of its own. The gas is maintained at a constant volume in a steel casing or bulb of high melting point, and the pressure measured by a very sensitive gauge of the foregoing design. This bulb is enveloped in an outer casing, the annular space being filled with a fluid which, while preserving the form of the bulb proper, at the same time is made to prevent diffusion of the gas in the central vessel by having an equal or greater pressure than that existing internally. The outer jacket may be surrounded by, or enveloped in, some material which prevents oxidation, without retarding the motion of the heat. For temperatures under 2000° F. it has answered fairly well in the preliminary trials, and experiments are being made to test its efficiency at still higher temperatures.

These are the most striking forms of these new or improved heat-indicators. To give a description of each design would try your patience, considering that there are over thirty-six forms of the apparatus, the greater number of which are for indicating temperatures up to the softening point of glass. The pressure-gauge, also, can be constructed in twelve different forms, depending on the pressure it is desired to register.

DISCUSSION.

Professor Mills said: I would like to ask Mr. Murrie a question about the thermometer on figure (No. 3) showing the lowest range of temperature. It is well known that in constructing a thermometer the operator heats the stem very strongly, and afterwards drives the mercury up it; the result of it is that where the mercury comes in contact with the hot stem it drives all air before it. At the extreme range of the mercury the thermometer can thus be sealed free from air. The reason for this is, of course, that if we have air inside the thermometer, and allow the mercury to move up and down, the air gets between the mercury and the glass, in varying amounts according to temperature. The same objection should apply to nitrogen or other gas. I should like to ask Mr. Murrie if any of these irregularities have been observed, and if it has not been found necessary to get rid of them by some means or the other. Then, again, as regards the sketch on my extreme left (Fig. 6), the bulb of the thermometer is filled with mercury, and is kept from deformation by being surrounded by mercury in another bulb. I suppose for this very high temperature the glass is very thick. The question is, Does the thermometer keep a constant zero, and does the bulb undergo any deformation? Of course the bulb when very strongly heated must become rather soft; and even at lower temperature glass is in fact a plastic substance. At a very high temperature it must become soft, and if thick must tend to float, and ultimately, therefore, become deformed. Of course this is only speculation based upon experience, but I should like to know what happens in both the cases I have mentioned.

In answer to Professor Mills, Mr. Murrie said: In the glass thermometer indicating to about 800° Fah. a difficulty is experienced in driving out the common air, and replacing it with nitrogen, a trace of oxygen having the effect of forming small specks on the inside of the tube.

Professor Mills: But does it not get between the mercury and the glass?

Mr. Murrie: Not so far as I have been able to determine. If the stem of the thermometer be heated at the same time, in the making of the instrument, no gas will adhere to the sides of the tube, and in practice the gas has not found its way between the mercury and the glass. If it did, the effect would be to break up the column of mercury into one or more sections, while my experience is that the employment of an elastic fluid in the upper extremity of the tube prevents this action, and permits the instrument being lowered in temperature with comparative rapidity, without the fear of the column splitting. Regarding Professor Mills' second question on the liability of the metal bulb changing its shape under continued heating: This can hardly take place if fitted with an outer jacket, and working in the way already described. When the instrument was a fixture and subjected to heat for any length of time, I would

depend more on the form of instrument shown on Fig. 3, where the pressure was measured by a gauge, and the corresponding temperature read off. I have made many experiments with a thermometer without the outer jacket, but fitted with an adjustable indicator, and after one or two trials with a new instrument, I found it was not necessary varying the indicator, the metal receding to a fixed point. Of course this was

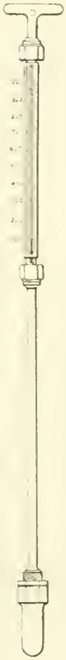


FIG. 8.

only in taking occasional measurements of temperature, where the instrument would only be a few minutes in contact with the heated body. This instrument is shown on Fig. 8. So far as variation is concerned, the only provision to be guarded against is the expansion of the metal forming the walls of the bulb, but this applies to the ordinary glass thermometer as well, and the variation is so small as to be immaterial.

Obituary.

DR. ADRIAN BLAIKIE.

AT the early age of 29 years, this promising young chemist passed away on the morning of Saturday, the 7th of February.

Dr. Adrian Blaikie was the fourth son of the Rev. Professor Blaikie, of the New College, Edinburgh. He received his school education in the Edinburgh Academy and Fettes College. When he was eighteen he went to Stuttgart, where he studied chemistry under Professor von Marx, during two years. Returning to Edinburgh, he entered on the science curriculum in the University, where he successively took the degrees of Bachelor and Doctor of Science. His success as a student is shown by his having been awarded the Baxter Physical Science Scholarship, and the Hope Chemistry Prize, at that time the two highest honours attainable in his special department; and his powers as an original investigator were proved by a series of papers on certain organic compounds of sulphur, the joint work of Professor Crum-Brown and himself, published by the Royal Society of Edinburgh, during the years 1877–9. After holding for one year the post of Lecturer on Chemistry at the University College of Bristol, Dr. Blaikie was appointed by the Government to assist the late Dr. R. Angus Smith in his important duties as the General Government Inspector of Alkali Works. To that work Dr. Blaikie brought skill, industry, and enthusiasm: so that he soon became, not only the official assistant, but the trusted friend of his chief. On the death of Dr. Smith, in May of last year, Dr. Blaikie was promoted in the service to the responsible position of the Inspector of the Tyne district; and in August he entered with ardour upon his new duties in Newcastle. But these were not to last long. Dr. Blaikie had never been very strong; and in the last week of November he was seized with an intermittent fever, which, after a lingering illness, resulted in his death early on Saturday morning, 7th February, at his father's house in Edinburgh. This event has deprived many of a friend, endeared to them by his refined and winning nature, and has cut off a young life of great promise.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Apparatus for Purifying and Softening Water for Steam Boilers, Laundry and Other Purposes. H. J. A. Bowers, Acton. Eng. Pat. 481, Jan. 3, 1884.

THE inventor separates the mineral and other impurities from the feed-water before its entry into the boilers, by first conveying it into a large pipe fixed in the steam space of a boiler. This pipe presenting a considerable surface to the steam in the boiler, the temperature of the water passing through approximates closely to that of the steam; the mineral and other impurities, which are liable to form scale or deposit in boilers, are thus rendered insoluble. The feed-water now passes from the pipe into an apparatus called the separator. This consists of two vertical chambers standing upon, and connected with, a lower vessel, which tapers downwards to a small outlet provided with a cock or valve. The feed-water enters at the top of the smaller vertical chamber, passes from thence into the lower vessel, in which the heavier insoluble particles are deposited, and then finds its way into the larger vertical chamber, entering at the lower end. This chamber contains suitable filtering materials, through which the water finally passes in its upward course, previously to its delivery into the boiler. The heavier impurities are drawn off from the lower tapering vessel by means of the blow-off cock or valve.—E. G. C.

Recent Improvements in Thermometrical Apparatus. Dingl. Polyt. Journ. 254 [4], pp. 158-161.

The pyrometer of Tremeschini (*Portefeuille économique des Machines*, 1884, vol. ix. p. 64) measures a rise of temperature by the expansion of a thin platinum foil. On using the apparatus, the scale A, sliding on B (Fig. 1), is placed opposite the zero-mark *a*. A copper rod H,

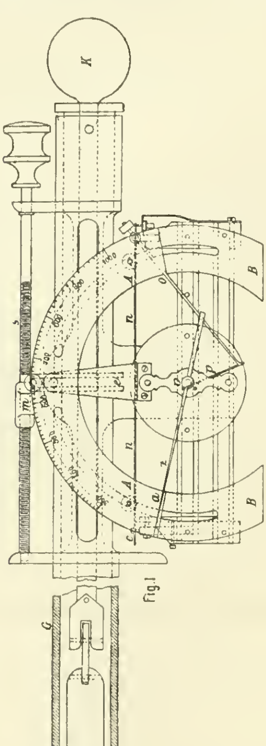


Fig. 1

surrounded by an iron tube G, is inserted into the space whose temperature is to be taken, and as soon as it has absorbed the necessary heat it is quickly withdrawn by means of a handle K, in such a manner that it faces the platinum foil *n*. The latter being fixed to *c*, its expansion is transmitted to the lever *o p*, which turns the finger *z*, and thus indicates the temperature on the scale A.

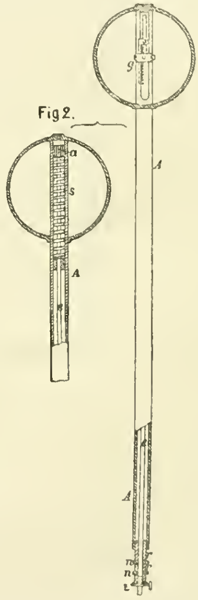
In the same French journal a description of Trampler's graphite pyrometer is given, which is similar to that known in commerce as Steinle and Hartung's patent.

Ducomet uses fusible alloys for the determination of high temperatures. Between a nut *z* and a tube A (Fig. 2), infusible rings, and such fusible at known temperatures of 5mm. height (*u* and *r*), are alternately inserted in such a manner as to stretch a spring *s*, which is in connection with a transmitting arrangement. By means of the nut *a*, the finger is fixed at the zero-mark. If now f. i. rings be used, which fuse at 200°, 400°, and 600°, the rod *e* will rise 5, 10 and 15mm. as soon as a temperature has been reached at which the rings fuse. The contrivance, therefore, only shows the highest temperature.

Guichard and Co. describe, in the *Revue industrielle*, 1884, p. 161, a finger-motion for metal-thermometers by means of a spring made of several metals. Such pyrometers are known to be very unreliable.

A. and E. Boulier, of Paris, have improved their water-pyrometer. The water which absorbs heat from the space whose temperature is to be measured, say a furnace flue, runs through the tap H (Fig. 3) into the pipe R,

Fig 2.



which is placed in the flue. From here it returns through pipe *r* into the receptacle N, where its heat is measured by a thermometer. It then travels through the tap O to the cup K, which is fastened to a beam, and held in equilibrium by a sliding weight T. A pliable rod *p* is fixed to the fulcrum of the beam in such a manner that it can first come into contact with the pin G, and then with F, as soon as the beam E swings owing to a decrease of weight at K. If, in consequence of an obstacle in the pipes, or owing to any circumstance the quantity of water entering K decreases, *p* and G come into contact, whereby an electrical alarum bell L is set in motion. If the water further decreases, *p* also touches the pin F, which causes the weight J to shut off the water at H. The pipe R, and all others conducting water from the flue to N, are covered with a non-conducting substance in order to avoid loss of heat.

R. Fluess, of Berlin (Germ. Pat. No. 26,606, 1883), has patented a maximum and minimum thermometer, in which the bulbs are filled with mercury, whereas the capillary tube contains an alcohol thread which is interrupted by a short mercury thread, which latter serves to

move the indicators. The real thermometrical substance in this case is mercury. If the length of the mercury thread be equal to 10 degrees of the scale, it is evident that the maximum and minimum scale will differ by 10 degrees. Fig. 4 shows such an instrument, whose mercury vessel A is forked for increasing its sensibility. The capillary tube B is filled with alcohol, and ends at the top in an enlargement which holds some air. The mercury thread *c* pushes the minimum mark *n* downwards, and the maximum mark *x* upwards.

size. The upper part of the cylinder is made into a settling tank, and a strainer placed between it and the hollow tube—in this case concentric with the screwed spindle—so that the solid matter is in part removed before the liquid is supplied to the filter bed underneath the revolving cutter plate; the filter therefore lasts a much longer time than it otherwise would without such provision. The patentee claims—(1) generally, the modifications as described; (2) the special form of apparatus illustrated in the filed drawing.—C. C. H.

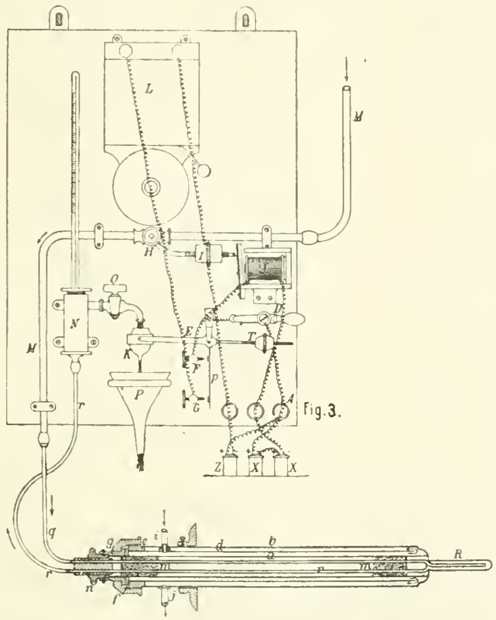


Fig. 3.

Fig. 4

According to J. M Crafts (*American Chem. Journ.* 1884, p. 307), the gradual rise of the zero-point in new thermometers is not caused by the air-pressure, but by the compensation of the tensions in the glass of the thermometer bulb. Thermometers filled with air show the same behaviour as those void of air. It is recommended to heat new instruments for some time at a high temperature before providing them with a scale, and use for fixing high degrees the boiling points of naphthalene (218·1°) and benzophenon (306·1°).—S. H.

Improvements in Filtering Apparatus. J. F. C. Farquhar, London. Eng. Pat. 3234, February 13, 1884.

THE subject of this invention is improvements in that class of filtering apparatus know under the name of the patentee, and for which former letters patent were granted. In this apparatus the filter bed is placed at the bottom of a cylindrical vessel, the upper surface thereof being scraped off by means of a revolving head carrying a cutter plate so that a clean filtering surface is always preserved; the liquid operated upon being introduced under pressure through a hollow screwed spindle, which at the same time advances the cutter plate beforementioned. In the present case, whilst preserving the same general form of apparatus, certain modifications are introduced in order to enable the filter to deal more successfully with liquids containing either a large percentage of suspended matter or bodies of a considerable

Improvements in Apparatus for Distilling Liquids, for Purifying Gas, etc. H. H. Lake, London. Communicated by P. A. Mallett and T. A. Pagniez, Paris. Eng. Pat. 3452, February 16, 1884.

THE ordinary apparatus in use for distilling thick pasty liquids, or those which contain much solid matter, are liable to the objection that deposits take place on their surfaces which cause obstructions in the proper working of the apparatus. The patentees in this case propose to remove such deposits, mechanically, as soon as formed, and for this purpose they construct a still as follows:—A column is built up from a number of segments, a rotating shaft passing through the whole. Trays for the reception of the liquid in its passage through the still are fixed alternately to shell of the column and the rotating shaft; their shape conical, the passage of the liquid being through the centre of the fixed tray and over the lip of the rotating tray. Scrapers keep their upper surfaces clean, and are so shaped that the material flowing on to the fixed tray from the lip of the rotating one is drawn towards the centre and passes through on to the surface of the rotating tray, the scraper running on which is so shaped that the matter is expelled over the edge of the tray on to the next fixed table and so on through the whole apparatus. A modification for liquids of a less viscous character is also described. Baffle plates cause the gas used for the operation to pass through the body of the liquid in bubbles during its passage through the still. The claims are (1) in a dis-

tilling column the combination of the rotating and fixed conical trays and spiral scrapers; (2) the arrangement of the conical scrapers; (3) the modifications as shown for liquids of a less viscous character.—C. C. H.

Novel Apparatus for Chemical Works. Dingl. Polyt. Journ. 255 [2], 71.

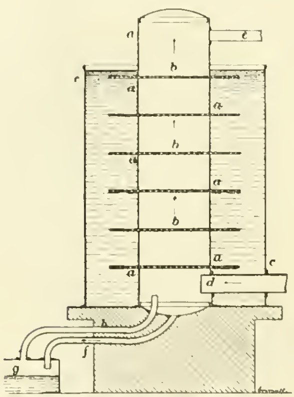
CH. A. BURGHARDT has patented (D. R. P., No. 29,155, January 24, 1884) a compound condenser with perforated plates, for the recovery of naphtha, benzol, and other solvents used in the caoutchouc industry.

The condenser consists of several circular tubes *a*, connected together to form a long vertical condenser, the tubes are separated by circular perforated plates *b*, which being of greater diameter than the condenser have their outer rims cooled by the water in the outer cylinder *c*. The condenser is thus divided into several chambers. The vapours pass in at *d*, and are drawn through the apparatus by connecting the upper part at *e* with a draught. The condensed liquid flows by means of the tubes *f* and *h* into the receiver *g*.

By erecting the condenser horizontally as in Fig. 2, the condensed liquid collects between the plates *a* by the three tubes *f* in three different states of purity.

A separating filter has been patented by C. Pieper in Berlin (D. R. P., No. 28,086, January 1, 1884). It consists, as shown in Figs. 3 and 4, of a frame *a*, in which vertical walls *b* are placed to support the filtering cloths *c*. The liquid enters the centre of the frame by the tube *d*, and is drawn off from the taps *c*, situated at the top and bottom of the apparatus.—S. R.

FIG. 1.



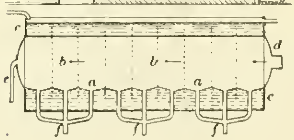
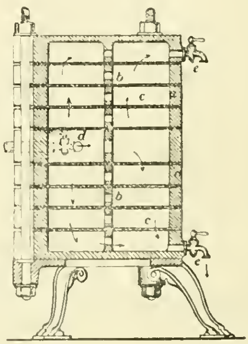


FIG. 2.

FIG. 3.



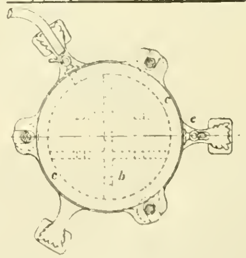


FIG. 4.

Improvements in Making and Working Filter Presses. James Pedder, Widnes. Eng. Pat. 3465, February 18, 1884.

THE improvements embodied in this specification are: (1) constructing filter-plates having a roll of flexible jointing material laced to a bead or projection formed on the joint surface of the plate; (2) securing the cloths used for filtering to a ring which fits tightly inside the frame portion of the plate, and holding the cloth against the filtering surface of the plate; (3) washing the soluble portions of the material under operation from the residue left in the press by first partially filling the chambers and then forcing the washing liquid through the sides of the unformed cake adhering to the cloths on each side of the chamber. The patentee claims as novel each of the improvements as above specified.—C. C. H.

Improvements in Filters. F. B. Hill, New Cross Gate, Surrey. Eng. Pat. 3578, February 19, 1884.

THIS patent is for improvements in water-filtering apparatus. The block of filtering material is placed in the interior of a containing vessel so that a narrow space exists only between it and the walls of the vessel. When the surface of the block has become coated, a rapid current of water is admitted through a tube in the upper part of the vessel, the direction of the axis of the pipe being on one side of the vessel, and not radially to the surface of the block; a surging gyrating motion of the water is thus produced in the narrow space which more effectually cleanses the surface of the filtering block. The dirty water is led away by a pipe at the bottom of the apparatus. The claim is a general one covering the construction of the filter as above described.—C. C. H.

Improvements in Treating Liquid or other Materials to Concentrate and Dry the same, and Apparatus therefor. J. B. Alliott, London. Eng. Pat. 3656, February 20, 1884.

THIS invention has special reference to those appliances in which semi-liquid matter is dried by means of currents

of heated air or gases brought into direct contact with the surface of the material, and is more particularly applicable to materials such as sewage or pail emptyings, which give off offensive odours during treatment. The patentee provides (1) a furnace which is used for heating a boiler or other useful appliance; (2) a pair of regenerative chambers through which the heated air from the boiler can be passed alternately, and which can also be put into communication with the chimney or a flue leading to the evaporating apparatus; (3) the drying vessels of the kind known as "Harescough's"; (4) the condensing apparatus; (5) a fan for drawing a current of air through the whole system. The exit pipe from the last piece of apparatus is in communication with the combustion chamber of the furnace. Supposing the dryers to be charged and the furnace in operation, the mode of working is as follows:—The fan is set in motion, and that part of the regenerators which has been previously charged with the heat is open to the air; the current of air passing into the chamber is heated to the temperature of the heated surfaces or nearly so, and being led from thence to the dryers over the surface of the material, takes up the water therefrom. Passing on into the condenser the moisture is removed, and the noxious vapours capable of being so condensed also removed; it is drawn from thence by the fan and forced into the combustion chamber of the furnace, where all gaseous bodies are thoroughly purified by the action of the heat. After doing useful work on a boiler or other useful appliance, the heated air is passed into the cooling chamber of the regenerator, where it gives up its heat to be transferred in its turn in a similar manner to the drying apparatus as first described so soon as the first chamber has cooled below its point of useful effect. The air is finally discharged into a flue leading to a shaft. The claims are (1) the mode of using air for the purpose and in the manner described; (2) using the products of combustion for heating regenerative chambers as described; (3) the combination of the different apparatus described as and for the purpose specified.—C. C. H.

Improvements in Filtering Apparatus for Gas, Air, Steam, and other Fluids. E. Capitaine, London. Communicated by Dr. Moeller, Kupferhammer, Germany. Eng. Pat. 3877, February 25, 1884.

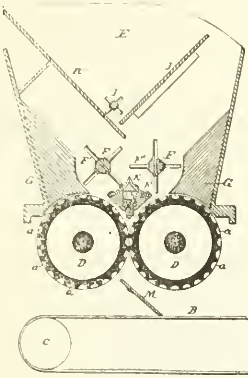
The filtering apparatus consists of a casing holding a frame, on which is disposed the filtering material made from any suitable material, and arranged in the form of pouches projecting into the interior of the casing upon which and the fixed frame it is secured by a movable frame. In some cases the pouches are kept open by a frame in their interiors. A similar apparatus in which the filtering material is arranged in the columnar form, is also described and illustrated. The patentee claims as novel (1) the pouch-like arrangement of the filtering material; (2) the suspension of the filtering media between two frames; (3) the arrangement in a pillar form; (4) maintaining the media in position by means of frames. —C. C. H.

Improvements in Apparatus for Mixing or Disintegrating Fluids and Semi-Fluid Substances. R. McNichol and I. Walsh, Manchester. Eng. Pat. 7680, May 14, 1884.

The apparatus consists of a cylindrical vessel provided on the exterior with a cover, and in the interior with three or more discs, one of which is joined to the cover by a tube, and the remainder to a rod entering the centre of the apparatus. The rims of the latter discs are furnished with slits inclined at right angles to each other in alternate discs. The rapid raising and lowering of the rod forces the material operated on through the inclined slits, thus producing rapid and effectual mixing. The points claimed as novel are (1) the apparatus described and shown in the drawings; (2) the use of diagonal slits in discs for the purpose set forth; (3) the use of the double lid.—C. C. H.

Apparatus for Moulding Artificial Fuel, etc. F. Loiseau, Philadelphia, U.S.A. Eng. Pat. 12,202, Sept. 9, 1884.

This invention relates to that class of machines in which the granulated pulverised or plastic material is fed to and between revolving cylinders having in their surfaces pockets, which, as the cylinders rotate, coincide with each other to form moulds for the material, the improvements being in the construction of these cylinders, and in the use in the hopper of a certain filling block and feed regulator, whereby the accumulation of the material above the cylinders is prevented, and the amount of material fed to the cylinders readily gauged so as to prevent undue excess.



The figure shows a transverse section of the apparatus. The composition is first stirred and brought to a granulated condition in the upper compartment of the hopper E by the blades of the horizontal shaft I, and when delivered into the lower part of the hopper, it is maintained in this condition by the stirring blades F. Underneath the revolving blades and somewhat above the point of contact of the moulding drums D, a feed regulating device K is suspended. This is composed of a stationary block K^1 and a movable block K^2. The material is moulded by the cavities in the drums D, and the blocks formed are delivered along an inclined screening chute M, on to the revolving apron beneath.—J. T.

Improvements in Apparatus for Compressing the Condensible Gases. S. Pulpett, Westmoors, Knowle. Eng. Pat. 12,543, September 18, 1884.

In the compression of the condensable gases heat is evolved, and in order to absorb this heat and to secure isothermal compression, a small quantity of the liquefied gas is sometimes injected into the cylinder during a part of the stroke. The present invention is to effect this automatically and in the correct quantity. To carry this into effect, the patentee provides a valve working either with a transverse or rotary motion, actuated intermittently by any suitable mechanism, enclosed in a casing in communication with the condenser in which is stored the liquefied gas. At a certain interval in the stroke the valve opens a passage into the cylinder, and a small portion of the liquefied gas is, by the superior pressure in the condenser, forced into the compression cylinder, and thus by its vapourisation secures the desired cooling effect. The claims are (1) utilising the pressure of the condenser for the purpose specified; (2) the valve for the same purpose moving transversely as shown in the drawings filed; (3) a cylindrical valve having a rotative reciprocating motion for the purpose set forth and described.—C. C. H.

A Composition for Preventing and Removing Incrustations in Steam and Other Boilers. Geo. Iles, Weeks Hill, and Thos. Morgan, Oldland, both in county of Gloucester. Eng. Pat. 750, October 2, 1884.

THE composition is called Iles and Morgan's Anti-Scrupp or Decrustation Composition, and consists of

Carbonate of Potash	10 parts per 100
Sulphate of Potash	5 ,, ,,
Chloride of Potash	5 ,, ,,
Carbonate of Soda	20 ,, ,,
Decoction of Hematoxylin	30 ,, ,,
Lime Water	30 ,, ,,

It is to be used in the proportion of half a pint per horse-power per six working days of twelve hours each.

—A. R. D.

Apparatus for Purifying Glycerine and other Substances. A. M. Clark, London. Communicated by F. H. Houghton, New York. Eng. Pat. 13,925, October 21, 1884.

THIS invention consists principally in combining a still which receives the impure glycerine with apparatus for supplying steam to such still, with a system of condensers and with an evaporator in which the products of condensation are freed from water.—J. T.

II.—FUEL AND LIGHT.

Some Experiments on Mineral Oil Lamps. By L. Schmelck. Dingl. Polyt. Journ. 255 [1], 39, and [2], 78.

THE author considers the effect of different oils, wicks, and chimneys in relation to some of the modern lamps used for burning mineral oils.

(1.) *Oil and Wick.*—The power with which the oil is drawn up the wick, diminishes as the oil is consumed, owing to the increased friction causing the velocity of the stream of oil to become less. The gradual removal of oil, of course, diminishes the luminosity of the flame, but the diminution is found to vary with the quality of oil employed. As vegetable oil, rape seed for example, is more viscid than the common mineral oil, specially constructed lamps should be used. Beilstein (Dingl. Polyt. Journ. 1883, 250, 169) has shown that the Russian oil, although the heavier, is more readily sucked up by the wick than the corresponding American oil.

The flame of a lamp increases in brilliancy for the first twenty minutes or so, till the lamp has acquired a uniform temperature, it then remains constant for about two hours, then begins slowly to diminish. To remedy this the wick is raised; if raised too high a crust forms on the top of the wick which, by stopping up the pores of the capillary channels, prevents the proper ascent of the oil. The different constituents of the oil appear to be sucked up at different rates. This is shown by a table giving the specific gravity of different oils, after different percentages have been consumed. Other things being equal, the luminosity of a flame depends on the breadth and strength of the wick; with three different kinds of wick, no difference was noticed in the rate at which they absorbed oil. As water prevents the rise of oil in the wick, all wicks should be well dried before use. After a while, a wick is impaired from the stoppage of its capillary tubes by particles of dirt drawn up by the oil in ascending. Experiments with incombustible wicks did not lead to any very satisfactory results. Lamps for preventing the sinking of the level of the oil, as used for vegetable oils, are not to be recommended for mineral oils for domestic purposes; they are used, however, in lighthouses. Ditmar uses in his lamp two wicks, one to supply the oil, the other to burn. The former of these is the stronger and reaches to the bottom of the lamp, the latter is shorter and is surrounded by the other at the top. If both wicks are of the same breadth, twice the quantity of oil is used in the same time. The best form is that known as Ditmar's "Sunburner B," with 15mm. burner.

(2.) *Burner and Chimney.* To obtain the maximum effect a fixed relation must be observed between the size of the flame and the amount of air admitted. An increase in the height of the chimney, of course, augments the velocity of the stream of air. If the chimney be lengthened without a simultaneous screwing up of the wick, a smaller but relatively brighter flame is produced. A greater current of air may possibly cause the particles of carbon to be a shorter time in the flame.

From a series of experiments with a *Reform burner* and *Kaiser oil* the author shows that the relative increase of brilliancy with a long chimney does not compensate for the diminution in the size of the flame. With a greater current of air, the consumption of the oil is quicker, and the intensity of the illumination less. The shape of the chimney is important. In round burners, as in the cosmos, the chimney causes the flame to contract in size. The fault with this and the Reform burner, which consists of a cosmos burner with a tube for the addition of more air to the interior flame, and for supplying the two sides of the flame with air at the same rate, lies in the chimney. The contraction being always at the same height does not vary with the height of the wick within. Rasch has tried to obviate this difficulty by a mechanical arrangement.

To bring air into the flame, the well-known burning plate is used in French lighthouses, and can be fitted to Ditmar's lamp, "Sunburner A," which is then used without the absorbing wick. In this lamp the chimney is not so contracted as in the cosmos, but has somewhat the shape of the old moderator lamps.

In the *Vulcan-cosmos burner* a large burning plate is used, which necessitates an enlarged chimney; one of these lamps burns one-third as much again of oil as the ordinary cosmos burner. The sinking of the oil so rapidly will therefore cause this flame to lose its brilliancy and intensity quicker than the other.

The *Mitrailleuse burner* burns, under favourable conditions, a little better than the cosmos burner, although the proper flow of oil is somewhat retarded by the metal fastening of the wick.

Amongst burners with flat wicks, the Duplex burner is still the best. It burns, however, 70grm. of oil per hour, about twice as much as a cosmos burner with 10mm. diameter. Both brilliancy and intensity of illumination diminish during burning. Most flat burners have the fault of heating the burner too much.

The greatest intensity of illumination of all lamps is obtained when the oil burns with the greatest flame, and this can be obtained by raising the wick as high as possible without the lamp smoking. In this investigation a modified Bunsen's photometer was used, and the standard light was that of four candles, weighing 396 grammes, and burning 35·9 grammes per hour.—S. R.

On the Luminosity of Methane. Lewis T. Wright. Proc. Chem. Soc. [3], 21.

PURE methane was prepared by Gladstone and Tribe's method, by the action of the copper-zinc couple on methyl-iodide. The gas was obtained free from methyl-iodide vapour by passing it through tubes fixed in a horizontal position and packed with copper-zinc, which was kept moistened with alcohol, the alcohol vapour being removed by scrubbing with sulphuric acid. It was burned in a London Argand burner, the chimney of which was fitted with a cap for the purpose of limiting the air-supply to the quantity most favourable to the development of luminosity. The methane flame was compared with a Methven standard burner supplied with eighteen-candle gas—*i.e.*, with a light equal to two sperm Parliamentary candles. The results obtained were—

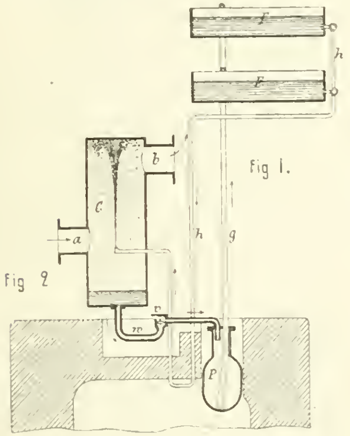
Rate of consumption per hour corrected to 60° F. and 30″ B. cb. ft.	Candles observed.	Candles per 5cb. ft. per hour calculated.
2·78	2·9	5·20
4·46	4·6	5·15

The author will extend his observations to ethane and propane.—W. S.

Separation of Ammonia from Gaseous Mixtures. Dingl. Polyt. Journ. 254, 434.

H. WELLSTEIN describes the following process and apparatus for the purpose (Ger. Pat. 28,762, 1883).

The lower bent portion of the tube *h* (Figs. 1 and 2), and the pulsometer P, are placed in a flue so that the contents may be heated. The gaseous mixture enters the chamber *c* by *a* and leaves by *h*, these tubes being provided with valves as shown in the figure. F is a reservoir of dilute sulphuric acid which flows into *c* by way of *h*, and is distributed as shown in the figure. When a



sufficient quantity of the dilute acid has collected in the floor of *c*, the valve in W is forced open and the liquid flows to P, where it is heated until the vapour tension is sufficient to close the valve and force the liquid by way of *g* to the second reservoir F. The circulation is maintained in this way until the sulphuric acid is neutralised by the ammonia, when it is interrupted during the introduction of fresh acid.—C. F. C.

Improvements in Self-acting Retorts for the distillation of Solid Substances. B. P. Walker, Birmingham, and J. A. B. Bennet, King's Heath. Eng. Pat. 491, January 3, 1884.

THIS invention relates to retorts constructed in accordance with a previous specification (Eng. Pat. 335, 1883), in which the material to be acted upon is made to traverse the length of the retort by the action of a screw into the threads of which the material is supplied from a hopper. The object of the present invention is to prevent the material from being carried round by the screw through the interposition of obstacles which form stops or detents, it having been found that in distilling certain substances the action of the apparatus is impeded by the adhesiveness of the material at certain stages of the process. Parallel with the propelling screw there is a second screw having the same pitch and direction of threads, the screw being arranged so that its threads shall lie between those of the propelling screw. The inventors also arrange a wheel the circumference of which is formed into cogs to correspond and work with the thread of the second screw. The turning of the screw gives rotation to the wheel, and the cogs clear out any adhering matter which may have been carried round by the screws, the wheel revolving within the walls of a pocket attached to the tube in which the screw revolves. —D. B.

Improvements in and Apparatus for the Manufacture of Gas for Lighting, Heating or other Purposes. Jno. Hy. Johnson. Eng. Pat 1193, January 10, 1884.

CONSISTS: (1) In injecting steam into the incandescent coke left in the retorts after the completion of the ordinary process of gas distillation, thus producing hydrogen and carbonic oxide. (2) In producing a gas of a higher illuminating power by injecting a liquid hydrocarbon into the coke left in the retort directly after the distillation of coal is completed. The gas produced may be mixed with the ordinary gas or with the water gas, produced as above described, according to requirements. (3) In the oxidation of the carbonic oxide contained in the gas mixture, which is produced in the first operation, to carbonic acid by passing that gas mixture, together with a further quantity of heated steam, through incandescent coke or through refractory materials heated in retorts. The latter operation may be carried out in a separate retort, into, and through which, the gas from the first operation is conveyed. From the gas produced in this manner the carbonic acid is removed by milk of lime, leaving thus pure hydrogen gas for use. The drawings illustrating the retort arrangement for this process are not of special interest.—C. C.

Improvements in the Treatment of Carbonaceous Substances in Ovens or Furnaces for the Conversion thereof into Combustible and other Products. H. Stier, Zwickau, Germany. Eng. Pat. 1198, Jan. 10, 1884.

ACCORDING to the present invention the construction of a furnace described by Glaser (Eng. Pat. 1962 of 1883) is made use of for treating carbonaceous substances in such a manner that after the removal of the volatile constituents by distillation, the residue is converted into combustible gas by admission of a regulated supply of air or steam into the incandescent mass, so that the operations of removing the volatile constituents and converting the carbonaceous residue into gas are effected consecutively in the same chamber of the furnace. To convert hydrocarbons such as mineral and other oils into aromatic substances, the hydrocarbons are introduced into the coking chamber filled with incandescent coke, the volatile constituents being condensed and permanent gases formed, whilst the solid residues in combining with the coke render this of a compact and improved quality. Carbonaceous substances such as lignite, peat, bituminous shales, which are not susceptible of coking, are treated in a similar manner, by first distilling from them the more volatile constituents, after which the residue is treated with air and steam for the production of combustible gases, which may be employed either directly for heating the coking chambers or for other purposes. —D. B.

Increasing the Illuminating Power of Ordinary Coal-gas. Wm. Godson Little. Eng. Pat. 1578, Jan. 17, 1884.

DESCRIBES an apparatus for carburetting ordinary coal-gas. The hydrocarbon proposed to be used is creosote oil of 9° to 10 Tw. This is supplied to an evaporating apparatus of hemispherical form (the flat side downwards), in which it is exposed in layers of ⅛in. depth indirectly to the heat of the gas-burner placed beneath it. To moderate the direct action of the heat from the burner on the bottom of the carburetter, a movable sheet-metal screen is interposed between it and the flame. The screen only is heated and communicates the heat to the carburetter. The carburetter is kept supplied with creosote from a reservoir placed above it, from which it flows to the carburetter in the proportion in which it evaporates in the carburetter.—C. C.

Improved Retort for the Production and Revivification of Animal Charcoal from Bones. G. Valentine, Liverpool. Eng. Pat. 1669, January 18, 1884.

THIS invention, which consists of a system of cast-iron vertical retorts of improved form and construction, is not suitable for abstraction, as without the assistance of the accompanying drawings it is impossible to explain the mode of working the retorts.—D. B.

Collecting Explosive Gas in Mines. A. Shippey, London. Eng. Pat. 1752, January 19, 1884.

THE inventor proposes to place gas-collecting vessels in excavations made in the roofs of mine workings in order

to entrap the lighter and combustible gases, and to connect these vessels with gas-holders at the surface.
—J. T.

Improvements in the Method of and Apparatus for Preparing and Treating Oils and other like Substances for Industrial Purposes. Frank Wirth, Frankfort-on-the-Main. Communication from L. Starck, Mayence. Eng. Pat. 1823, January 21, 1884.

LIQUID hydrocarbons or other oils and fatty substances, resins and bitumens which become liquid at a higher temperature than that of the atmosphere, are converted into a permanent solid form by mixing moss peat having a specific gravity of 0·09 therewith. About 100 parts of the latter mixed with from 400 to 600 parts of crude petroleum produce a fibrous mass which can be subjected to various temperatures in boilers, retorts or chambers, in order to separate the carburetted hydrogen disengaged, a furnace provided with iron or clay retorts laid in a horizontal position being used. This furnace, which has three series of retorts—viz., a central series and a series on each side of it—permits the retorts to be heated to any temperature ranging between 80 and 1800°. The central retorts are surrounded by a wall and are exposed to the direct action of the fire. Through the arch of the inner oven thus formed, the heat passes to the outer ovens, in which are placed the side series of retorts and around which the hot gases play previous to passing into flues which are provided with dampers. Where the temperature is lowest steam is admitted and, by reason of the low temperature, is condensed. Where the temperature is highest, carburetted hydrogen gas is evolved and either converted into lamp-black or mixed with hydrogen to form lighting or heating gas. The hydrogen gas is produced by decomposing steam or water in the central retorts. To produce large quantities of lighting or heating gas it is proposed to add to the moss peat saturated with oil 400 to 600 parts of fine coal. In the preparation of lighting gas, resins or similar substances may be used instead of crude petroleum. The lighting gas is purified by passing it through a mass of peat moss and lime, or gypsum. To bleach lubricating oils produced from crude petroleum the oily peat moss is treated with chloride of lime, the lubricating oil being extracted by steam heated to 250°.—D. B.

Combined Gas Producer and Steam Boiler. B. C. Sykes and J. Briggs, Cleckheaton. Eng. Pat. 2709, February 5, 1884.

THE inventors surround a gas generator by a water jacket below and a steam space above, the arrangement much resembling an ordinary vertical boiler. The gases produced are drawn off from the upper part of the producer by tubes which pass vertically down through the water space.—J. T.

Gas Purifier Grids. H. J. Haddan, London. Communicated by John Calot, Massachusetts, U.S.A. Eng. Pat. 3223, February 13, 1884.

EACH bar of the screen or grid is formed with, practically speaking, linear or very narrow bearings to rest against peripheries of each of the holes for supporting it, the bar being between such bearings without contact with the periphery or broadway of the hole; that is, the edges only of the bars touch the holes in the supports.—J. T.

Improvements in Carbonising Coal. J. G. Willans, London. Eng. Pat. 3520, February 18, 1884.

THIS invention relates to the carbonising of coal in gas retorts or in coke ovens. It consists in causing the vapour of water to be disseminated through the coal during the heat. A substance containing water is either placed underneath the coal or is mixed with it. In either case the water will be vapourised and disseminated through the coal during the heat. The substance employed may be slaked lime or other mineral substance containing combined or included water, or it may be a carboniferous substance such as moist or wet peat, or wet coal dust.—J. T.

Improvements in the Methods of Taking off the Volatile Products from Coal, Shale and other Hydrocarbons during the Process of Distillation. W. A. Byrom, Wigan and J. A. B. Bennett, King's Heath. Eng. Pat. 3736, February 22, 1884.

THE object of this invention consists in removing from the retorts the various products of distillation, and thus preventing them from mixing and avoiding the subsequent expense of redistillation. A retort similar to that patented by Walker and Bennett is employed. In this retort a number of apertures are placed in a line along the highest part of the retort, and arranged in such positions as to be able to withdraw the products immediately they are liberated. This is effected by supplying each exit pipe with a bend of any suitable form, so that the pipe may ultimately be either inclined downwards or preferably point vertically downwards near the side of the retort, the exit pipe being of sufficient length to secure the condensation of the liquid portion of the distillate. The latter runs down the exit pipe and falls into a receiver, whilst for the removal of the gas each exit pipe is furnished with a lateral opening above the point where it enters the receiver. These openings are connected with a horizontal pipe through which the gas is drawn off by means of an exhausting apparatus.
—D. B.

Improvements in Method of and Apparatus for Washing and Purifying Coal-gas. J. F. Belfield, Exeter. Eng. Pat. 3870, February 25, 1884.

THE apparatus consists of a series of horizontal trays, containing water, and having concentric rings of pegs. Above these trays are revolving discs with pegs on their under sides, alternating with those in the trays. The discs are rotated by an arrangement of levers and movable weight, and secondary steelyard adjustment for regulating back pressure.—S. R.

Producing and Burning Gas for Heating Purposes. L. D. York, Portsmouth, Ohio, U.S.A. Eng. Pat. 3939, February 26, 1884.

THE gas generators are worked in pairs. Each is provided with a grate and closed ash-pit, and the two are connected above by a short flue, into which opens a small steam pipe. Air is forced beneath each grate alternately, and the gas produced is taken off below each grate alternately. Thus, the gas produced in the generator receiving air is passed downwards through the fuel in the other producer; and during the passage of the gas from one to the other, more or less steam is introduced by the pipe mentioned above.—J. T.

Condensing Apparatus for Purifying Coal-gas. W. T. Walker, London. Eng. Pat. 3987, February 26, 1884.

THIS invention relates to improvements in Walker's annular condenser (Eng. Pat. 545, 1880). The inner and outer condensing cylinders are so made that the space between them is conical, the narrower part being upwards to prevent the deposition of naphthalene between the cylinders. Large tar outlets are made direct through the bottom closures of the spaces between the cylinders. The bottom closures of the cylinders are inclined down to the tar passages. The cooling of the cylinders is effected by means of annular troughs placed at the upper part of the cylinders, with a filling of thick felt (or equivalent porous material) between these troughs and the surfaces of the cylinders; and through this felt the water percolates, and is distributed evenly over the whole surface of the cylinders.—J. T.

Apparatus for Carburetting Air. J. H. Johnson, London. Communicated by E. D. Deboutteville and L. P. C. Malandin, Fontaine le Bourg, France. Eng. Pat. 6652, February 26, 1884.

THE apparatus consists of a vessel, preferably of cylindrical form, for containing the liquid hydrocarbon, divided internally by pendant vertical partitions, extending to within a short distance from the bottom, and preferably arranged in the form of a double spiral. The lower edges

of these partitions are immersed in the liquid, and air is admitted at one side of the apparatus, and is compelled to follow the convolutions of the passages formed by the partitions, till it reaches the centre of the vessel, and then flows in the opposite direction to the outlet. Thus, the air is brought into contact with an extensive surface of the liquid hydrocarbon, whereby it is carburetted under very favourable conditions.—J. T.

Improvements in Gas Producers of the Siemens Type. James McFarlane, Motherwell. Eng. Pat. 4075, February 28, 1884.

By means of these improvements small coal or dross can be utilised in gas producers of the Siemens type, thus enabling such gas producers to yield a larger quantity of gas in a given time. The gas producers are constructed with an enclosed hollow bottom, underneath the bottom proper. Passages in the hollow bottom are connected with perforations in the bottom proper, and with side openings around the bottom. Air, or a mixture of steam and air, is injected by means of a steam blower through these passages into the small coal, and so converts it into gas.—S. R.

An Improved Method of Utilising the Waste Residues of Fuel. Eng. Pat. 4698, March 11, 1884.

Nine hectolitres of the waste are thoroughly mixed with a hectolitre of fine black coal, and nine litres of coal-tar, diluted with one litre of ordinary petroleum, are poured upon the mixture; after well stirring, a solution, containing 0·75 kilogrammes of calcined carbonate of sodium (dissolved in from 15 to 20 litres of water) is added, to form an emulsion, from which cakes are formed and dried. —S. R.

Improvements in the Process of Manufacturing Hydrocarbon Gas. E. A. Brydges, Berlin. Eng. Pat. 6455, April 17, 1884.

The object of this invention is to cheaply obtain an illuminating gas, pure and free from oxygen and carbonic acid gas. Superheated steam is passed over heated lime, to absorb oxygen and carbonic oxide; then over finely divided iron or copper; and finally over charcoal, to remove the last traces. The hydrogen so obtained is mixed with a liquid hydrocarbon, and then passed through a heating coil, which converts the mixture into a fixed gas. The gas is purified by passing through a washer and chamber supplied with hydrate of lime, ammoniac and water, or other suitable cleansing solution.—S. R.

Manufacture of Illuminating or Heating Gas and Apparatus for the same. A. J. Boult. Eng. Pat. 9084, June 17, 1884.

The generating and fixing chambers are heated, the one by the combustion of the fuel, the other by the products from such fuel. Steam is decomposed in the fuel, hydrocarbons are added, and the mixture fixed by passage through part of the heated material. Successive volumes of the gas are passed through succeeding parts of the heated material, thus preventing destructive decomposition of the hydrocarbons, and ensuring a gas of uniform candle power. To effect this, two generating chambers are used and operated reciprocally, the superheated steam being passed alternately down into one, and the resulting gases up through the other. The coal is also distilled alternately in the two chambers. The steam is decomposed by passing first through a bed of heated iron scrap, and then through the incandescent fuel. The oxidised scrap is reduced by subjecting it to the action of nascent carbonic oxide, which, in company with the other waste products of combustion, is passed up the superheating and decomposing chambers. Since this is reversible, the scrap can be used repeatedly without removal from the apparatus.—S. R.

Improvements in and connected with Retorts for obtaining from Coal or other Carbonaceous Substances Illuminating or Heating Gas, Oil, Coke and other Products. J. Hislop, Glasgow. Eng. Pat. 12,912, September 29, 1884.

The inventor employs fireclay retorts formed of one or more large pieces, or being wholly or partly built up of firebricks. The retorts are of oblong form in horizontal section, each having a passage formed down the inside of it by a small partition built near one of the narrow sides. The sides of the partition being perforated, the gas generated at any part of the retort has immediate access into the side passage. The latter communicates by a number of horizontal branch pipes with an external vertical pipe, which is, at its top, connected with a pipe leading from the top of the retort to the gas main, condensers and separating apparatus. On the outer side of the vertical pipe, and opposite the branch pipes, nozzles are fitted, provided with plugs, to facilitate the clearing of the horizontal connecting pipes. The retorts are arranged in various ways in connection with ordinary furnaces. A furnace may, for instance, be arranged to a set of four retorts, communicating directly with the bottom ends of the retorts, these bottom ends being nearly horizontal, and having short horizontal outlet parts, extending through the side walls of the building for the discharge of the coke or residues.—D. B.

Hydrocarbon Furnaces. H. J. Haddan, London. Communicated by A. N. Leet and E. Neumann, New Jersey, U.S.A. Eng. Pat. 13,948, October 21, 1884.

Petroleum or hydrocarbon liquid is often used as a source of heat in steam generators. The present invention does not require any change in the construction of the ordinary combustion chamber, where solid fuel has been employed. On the usual firegrate is placed a shallow pan of iron with open top, which is kept supplied with petroleum. In front of the tank is placed a series of horizontal jets, supplied with steam by the boiler itself, or from a supplementary source when commencing work. The hydrocarbon is ignited, and by means of the jets of steam the flame is spread, a large quantity of air is caused to rush in from below, and the flame becomes very powerful. —J. T.

Improvements in the Manufacture of Gas. W. L. Reddie, London. Communicated by R. A. Chesebrough, New York. Eng. Pat. 14,260, October 28, 1884.

This invention consists in an improvement in the manufacture of gas, by subjecting bone-black charged with oily or hydro-carbonaceous matter, to a heat sufficient to vapourise the hydro-carbonaceous matter, and convert it into a permanent gas. A vertical retort is employed, provided with a hopper at the top, and a feed roller; inside are sloping shelves, down which the bone-black is supposed to pass gradually to an exit port at the bottom, which leads into a cooler. At the top of the retort is an outlet for the permanent gases formed. A second form of retort is a spiral tube, down which the bone-black is supposed to be capable of passing.—J. T.

Improvements in Self-sealing Mouthpieces and Lids for Retorts, Stills, and Generators employed in the Production of Gas from Coal and other Substances, and for the Distillation of Chemical and other Liquids. S. Adams, London. Eng. Pat. 15,447, November 24, 1884.

This invention consists of a collar or pad forming a seal made of pure asbestos, spun or plaited into square or round cord, the collar being inserted in a dovetail or elongated groove, either in the face of the lid or mouthpiece, as may be required. It is also claimed to cover the core of asbestos with fine metal wire, to protect the fibres from being drawn from the collar by adhering to the lid or mouthpiece when the lid is opened.—D. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Preparation of Pure Thiophene. Victor Meyer. Berichte, 17, 2641.

The preparation of crude thiophene—that is to say, a mixture of about equal parts of benzene and thiophene—does not offer any difficulties, whereas that of pure thiophene is a laborious operation, and is often accompanied by loss of material.

By limiting the quantity of sulphuric acid used in extracting the thiophene, no benzene is dissolved. The thiophene sulphonic acid, obtained in this way, gives, on distillation, chemically pure thiophene. Should even a portion of the thiophene remain behind in the benzene, the advantage of the method counterbalances any loss from this cause.

These experiments were conducted on the large scale, but the process is not to be recommended for laboratory use. 2000kilos. of pure benzene boiling within half a degree were agitated for six hours, with 100kilos. concentrated sulphuric acid, and the black layer of acid, amounting to 90kilos., separated. 20kilos. of this were converted into the lead salt, and 3·2kilos. of the crude salt obtained gave on distillation with salammoniac chemically pure thiophene. 135grm. thiophene were obtained from every kilogram of lead salt. An analysis of the product indicated the total absence of even traces of benzene. It is important not to add water directly to the black layer of acid, as in this case it completely carbonises on standing. From the author's experiments the following quantities are recommended for obtaining an absolutely pure product: 400kilos. benzene, to be shaken for two hours with 16kilos. sulphuric acid. The black mass is then converted into the lead salt, the lead precipitated with sulphureted hydrogen, and the acid treated with ammonia to obtain the ammonia salt, and finally distilled.—J. B. C.

Nitrification of Thiophene. Victor Meyer and O. Stadler. Berichte, 17, 2648.

Since the discovery of thiophene, attempts have been made to nitrify this substance, and thus to show its analogy with the benzene derivatives. After many unsuccessful efforts, the desired result was obtained by passing a current of air saturated with thiophene through fuming nitric acid. Mononitro-thiophene possesses properties more analogous to paranitro-toluene than to nitro-benzene. It has the characteristic smell of nitrobenzene and nitro-toluene, boils at 224-225° C., and melts at 44°. With fuming nitric acid, it is converted into binitro-thiophene. Binitro-thiophene melts at 52°, and boils at 290°. An isomeric binitro compound may also be obtained from the crude product, crystallising on needles, and melting at 75-76° C.—J. B. C.

Acetothiënone and its Derivatives. A. Peter. Berichte, 17, 2643.

The method of Friedel and Craft may be employed in the case of thiophene. This has been demonstrated by Comey, who obtained phenylthiënylketone. The author, working in the same direction, prepared the acetyl derivative. To 20grm. crude thiophene (50 per cent.), and 9grm. acetyl chloride, 1·5grm. aluminium chloride are slowly added, quantities of hydrochloric acid being evolved. The yield is not so satisfactory as that obtained by first dissolving the thiophene and acetyl-chloride in petroleum ether, before adding aluminium chloride. Repeated agitation of the mass during the reaction is desirable. When on the addition of aluminium chloride no further evolution of HCl occurs, the reaction is at an end, the petroleum is poured off, the product warmed and poured into water. It separates out as a heavy dark coloured oil. After shaking out with ether, the petroleum previously separated is added. The whole is washed with soda and distilled. After the ether has come over, the heavy liquid is directly distilled, shaken with soda solution and again fractionated. Acetothiënone or methylthiënylketone $C_4H_3S-CO-CH_3$ is a colourless oil, resembling acetophenone in smell, and boiling at 213·5° C. It combines with hydroxylamine, forming thiënylmethylacetoxime, and with phenylhydrazine, a crystalline yellow compound being obtained. By the oxidation of acetothiënones with an alkaline solution of potassium permanganate, an acid having the constitution C_4H_3SCOOH is obtained. Acetothiënone may be nitrified by allowing it to drop into fuming nitric acid cooled to 8°. The product consists of two isomeric mononitro acetothiënones, which may be separated by fractional crystallisation from ether and alcohol.—J. B. C.

Quinoline from Coal-Tar. M. C. Traub and C. Schärges. Berichte, 17, 2618.

One of the authors in a former paper prepared a phthalic acid derivative of quinoline, which was shown by Jacobsen and Reimer (Berichte, 16, 2602) to be a quinaldine derivative. The authors have experimented with quinolines from different sources, which did not give this derivative. With a view to discovering the cause of this difference, various reactions were tried. They found that by treating quinoline from coal-tar with phosphorus pentoxide on the water bath, an intense red colouration is produced, and by diluting the product with water or alcohol, the solution gives a beautiful greenish yellow fluorescence little inferior to that of fluoresceine. Neither quinoline prepared by Skraup's method nor quinaldine give analogous reactions. The different fractions from coal-tar give dissimilar results. A distillate under 200° behaves like pure quinoline, that under 230° gives a faint reaction, whereas the portion distilling at 235° produces the most intense fluorescence. Above 235° the reaction is faint. This method of treatment with phosphorus pentoxide is a useful means of rapidly detecting a coal-tar quinoline, and gives reason to believe that in addition to quinoline and quinaldine, a third body is present in this fraction of the coal-tar bases, the isolation of which the authors purpose to attempt.—J. B. C.

Monobromoparaxylene. P. Jannasch. Berichte, 17, 2709.

In consequence of a paper by O. Jacobsen (Berichte, 17, 2379), stating monobromparaxylene to be a liquid not solidifying in a freezing mixture, contrary to the observations previously made by Fittig and the author, the latter prepared the pure compound from pure paraxylene and bromine in the cold. The product thus obtained boiled at 199-201°, and solidifying in a freezing mixture to a crystalline mass, melting at 9-10°, thus confirming the author's previous observations.—J. B. C.

IV.—COLOURING MATTERS AND DYES.

Method for the Preparation of Naphthylamine Compounds. Dingl. Polyt. Journ. 1884, vol. 254. p. 232.

In order to replace the hydroxyl group of the naphthyl compounds of the β series by the amido group, a pressure of 30 to 40 atmospheres is necessary in the methods at present adopted. In order to avoid this, L. Landshoff, of Berlin (Ger. Pat. 27,378, January 23, 1883), proposes the following method: The alkaline salts of the β-naphthol sulphonic acids are, at a temperature of 200 to 250°, subjected to the action of gaseous ammonia, the latter being passed over them in a slow current for about 12 hours. The following formulæ explain the reaction which takes place:—

$$C_{10}H_6.OH.SO_3M + NH_3 = C_{10}H_6.NH_2SO_3M + H_2O, \text{ or}$$
$$C_{10}H_5.OH.(SO_3M)_2 + NH_3 = C_{10}H_5.NH_2(SO_3M)_2 + H_2O, \text{ or}$$
$$C_{10}H_4.OH.(SO_3M)_3 + NH_3 = C_{10}H_4.NH_2(SO_3M)_3 + H_2O.$$

This method is applicable to all known sulphonic acids of β-naphthol. The alkaline salts of the β-naphthylamine sulphonic acids thus obtained, when converted into the diazo-compounds, and combined with amines, phenols, oxyphenols, naphthols, or their ethers and sulphonic acids in the well-known manner, form colouring matters

varying in the phenol series from yellow to orange and brown, in the α-naphthol series from red to bluish violet, and in the β-naphthol series from yellow orange to red orange.—F. M.

On the Preparation of Isatin. Dingl. Polyt. Journ. 1884, vol. 254, p. 232.

According to a patent (No. 27,979, December 22, 1883) taken out by F. Bayer and Co., of Elberfeld, the direct melting together of dichloracetic acid and analogous compounds, with amines of the aromatic group, is only to be recommended in case of the less reactive amines. When the more reactive amines, such as aniline, toluidine, phenylenediamine, etc., are used, the reaction, even on the water-bath, proceeds so violently, that valueless resinous products are chiefly obtained. In such cases the reaction should be made to take place in solution, alcohol, benzene, etc., being used as solvents. In order to increase the yield of isatin which, when the product of the reaction is worked up directly, is only small, the latter is previously subjected to a process of oxidation. This may be accomplished by passing a current of air through the solution of the product, or by keeping it exposed to the atmosphere, whereby crystals or crystalline masses of almost pure imesatin separate out. This body, which forms the intermediate product in the preparation of isatin, has been found, by careful researches, not to be the original chief constituent of the product of the reaction, but to be formed by the spontaneous oxidation which takes place during the reaction and the purifying process in a more or less imperfect degree. Imesatin and its substitution products are, therefore, obtained in larger quantities by more complete oxidation, as in the manner above described. Instead of the derivatives of the disubstituted acetic acids, the amides and aldehydes, also their alkaline salts and ethers, may be employed.—F. M.

On Malachite Green. Dingl. Polyt. Journ. 1884, vol. 254, p. 316. (Ger. Pat. 27,275, September 15, 1883. Dittler and Co., Griesheim, near Frankfort-on-the-Maine.)

By adding chloride of lime to an acidulated aqueous solution of a salt of malachite green, bluish-green colouring matters are formed. 25kilos. of the oxalate of tetramethyl-diamidotriphenyl-carbinol are dissolved in 1000 litres of cold water, and acidulated with 50kilos. of acetic acid. To the solution 7kilos. of chloride of lime are quickly added under stirring, the whole being allowed to stand for half an hour. From the filtered liquor the colouring matter is separated by the addition of ammonia, dissolved in hydrochloric acid, and precipitated again with common salt. By using a larger quantity of chloride of lime (20kilos.) a colouring matter of a bluer tinge is obtained. An analogous product is formed by employing a solution of bromine in caustic soda instead of chloride of lime. To a solution of 53kilos. of malachite green (oxalate) in 2000 litres of water, 100kilos. of hydrochloric acid, and then 18kilos. of bromine dissolved in caustic soda, are added, the colouring matter being immediately afterwards precipitated by means of ammonia. The colour base thus obtained forms a bronze coloured mass; its salts dye bluish green shades. By increasing the quantity of bromine used the shade becomes bluer, as in the previous process. The salts of tetraethyl-diamido-triphenyl-carbinol behave in a similar manner, but yield more yellow shades.—F. M.

Method for the Manufacture of Dinitrophenol Sulphonic Acid. Dingl. Polyt. Journ. 1884, vol. 254, p. 356. (Ger. Pat. 27,271, June 8, 1883. Beyer and Kegel, Lindenau-Leipzig.)

By boiling potassium mononitro-phenol-parasulphonate (obtained from potassium phenol-parasulphonate) with dilute nitric acid, until no more gases are given off, a salt is obtained which in acid solution possesses a yellow colour. The same colouring matter is obtained by boiling potassium phenol-para sulphonate with nitric acid in excess:

$$C_6H_4.OH.SO_3.K + 2NO_3H = C_6H_2.OH.SO_3K(NO_2)_2 + 2H_2O$$

The potassium salts of phenol-orthosulphonic acid or mono-nitrophenol-orthosulphonic acid by the same treatment yield an isomeric body dyeing similar shades to the para-compound, but being more soluble in water than the latter. The same colouring matter is obtained from potassium phenol-disulphonate by treatment with moderately dilute nitric acid. Instead of the potassium salts of the phenolsulphonic acids, their sodium, magnesium or calcium salts may be used. The sulphonic acids may either be used single or mixed to obtain the same colouring matters. Instead of boiling with dilute nitric acid, the phenolsulphonic acids or their salts may be treated with strong nitric acid, or a nitric acid mixture in the cold, the reaction being completed by subsequent heating. Diazo-benzene-parasulphonic acid which, on boiling with water, yields phenol-parasulphonic acid, by being heated with dilute nitric acid naturally forms the same body as phenol-parasulphonic acid, and diazo-benzene-disulphonic acid, derived from ordinary aniline disulphonic acid, the same body as phenol-disulphonic acid.—F. M.

Nitro and Amido Derivatives of Metaxylene. E. Grevingk. Berichte, 15, 2422.

By nitrating metaxylene with nitric acid, Fittig obtained a dinitroxylene (m.p. 93° C.). By employing a mixture of sulphuric and nitric acids, the author obtained in addition to the one melting at 93° C., a dinitro compound of melting point 82° C. 100grm. pure metaxylene, 700grm. sulphuric acid 66° Bé., and 300grm. nitric acid 48° Bé., are brought together and surrounded by a freezing mixture, the temperature being maintained between 3 and 6° C. By varying the quantities of nitric and sulphuric acids, a mixed product of the two dinitro bodies is invariably produced, though in different proportions; and an increase in temperature occasions the formation of a trinitro compound. The two dinitroxylenes are best separated by fractional crystallisation, from alcohol or glacial acetic acid, that of m.p. 82° C. being very much more soluble than that of m.p. 93° C. The operation is, however, a very tedious one, repeated recrystallisations being necessary in order to ensure complete separation. Both dinitroxylenes, on treatment with a mixture of H_2SO_4 and HNO_3, give the same trinitroxylene of m.p. 176° C., first prepared by Fittig. If the trinitroxylene of Fittig has the methyl and nitro groups in the positions 1·3:2·4·6, then it follows that the two dinitroxylenes must have the constitutions 1·3:4·6 and 1·3:4·2 respectively.

Metanitroxylidine 1·3·4·2 dinitroxylene m.p. 93° C., gives a nitroxylidine m.p. 123°, crystallising in deep red compact crystals. From the dinitro compound of m.p. 82° C., by reduction with H_2S, in alcoholic ammonia solution, a totally distinct amido body was formed, melting at 78°, and crystallising from petroleum spirit and water, in golden needles, liquids in which the first xylidine is almost insoluble.

Metadiamidometaxylene 1·3·4·6. By reduction of nitroxylidine m.p. 123° C. with stannous chloride and hydrochloric acid, and precipitation of the tin by H_2S, an almost colourless diamine salt is obtained. This gives the free base in the form of a brown mass, from which the pure compound (m.p. 104 C.) can be prepared by sublimation in colourless crystals. It is identical with the base obtained from dinitroxylene m.p. 93° C.; and by nitrification and reduction with the 1·3·4 xylidine of Nölting and Collin. The hydrochloride gives, with sodium nitrite, a Bismarck brown.

Metadiamidometaxylene 1·3·4·2 is prepared by the reduction of nitroxylidine m.p. 78° C., and crystallises in colourless needles m.p. 64°. In this case tin and hydrochloric acid were employed in preference to the chloride, and a modified method of purification was necessary. The colour reactions with sodium nitrite showed that this compound is likewise a meta-diamine.

Triamidometaxylene is prepared from the trinitroxylene m.p. 176°, by reduction, and is purified by sublimation. By diazotising the hydrochlorides of the amines with

sodium nitrite, yellowish brown colouring matters are obtained, which impart to silk, in a soap bath, various shades of brown. That from diamine, m.p. 64°, gives a red brown, that of m.p. 104° a yellow brown, and from the triamine a grey olive. With diazobenzenesulphonic acid different colours are formed. Light yellowish red from the first, a deeper shade of the same colour from the second, and a dark red from the triamine. Dyed on silk, the shades from these varied in exactly the contrary order, that from the triamine giving the lightest, that from diamine m.p. 64° the deepest shade. Metaxylidine 1·3·4 gives, on nitrification, at low temperature, two nitroxylidines of m.p. 123° and 78°, identical with the two already described. By eliminating the amido group from the two latter, with ethyl nitrite in a sulphuric acid solution, two nitrometaxylenes are obtained, that from nitroxylidine m.p. 123° C., boiled at 238° C., identical, therefore, with Tawildarow and Harmsen's nitroxylene 1·3·4; the second, from nitroxylidine, m.p. 78° C., gave a nitroxylene of b.p. 225° C., which must possess the constitution 1·3·2. From metanitroxylene, a metaxylidine, 1·3·4, was prepared by reduction, b.p. 215° C., identical with that of Hofmann and Schmitz; and from nitrometaxylene, a xylidine of b.p. 214·5°, and of constitution 1·3·2.
—J. B. C.

Process for the Manufacture of Naphthol-green. Dingl. Polyt. Journ. 254 [4], p. 184.

THE Frankfort aniline dye works of Gans and Co. (Ger. Pat. 28,065, 1884) dissolve 27½kg. of sodium nitroso-β-naphthol-monosulphonate in 100 litres of water, and after cooling, add 20 litres of iron perchloride solution, containing 5kg. Fe_2Cl_6. After allowing to stand at rest for some hours, the iron in excess is removed by the addition of an alkali. The mass is filtered, and the green filtrate evaporated to dryness. To obtain the green dyestuff in a pure state it must be either recrystallised out of dilute alcohol, or precipitated from its alkaline solution with a lead salt; the precipitated lead compound is then decomposed with dilute sulphuric acid. In place of Schaeffer's monosulphonic acid, all other naphtholsulphonic acids may be used, save β-naphthol-α-monosulphonic acid and β-naphthol-γ-disulphonic acid. If iron is replaced by an equivalent quantity of cobalt salt, brown dyestuffs are obtained; nickel yields a yellow dyestuff. All these substances belong to that still little known class of organic compounds containing metals, which dye wool and silk in an acidulated solution. An excess of acid causes the disappearance of the dye, which reappears again on neutralising the excess of acid.—S. H.

Substitution of the Amido Group by Chlorine, Bromine, and Cyanogen in Aromatic Compounds. T. Sandmeyer. Berichte, 17, 2650.

THESE substitution products are obtained by the action of the cuprous compounds of the halogens on the diazo-derivatives. To prepare metachlornitrobenzene from metanitraniline, 4grm. of the latter are dissolved in 7 grm. hydrochloric acid (sp. gr. 1·17), 100grm. water, and 20grm. of ten per cent. cuprous chloride solution added, and the whole heated almost to boiling. From a separating funnel, 2·5grm. of sodium nitrite in 20grm. of water are added, drop by drop. A heavy oil collects at the bottom of the vessel, nitrogen being evolved, and the oil, on cooling, solidifies. A yield of 4grm. metanitrochlorobenzene was obtained of m.p. 45°. By acting upon paratoluidine in a similar manner, and distilling the product of the reaction with steam, parachlortoluene was formed, boiling at 156° to 157°. On adding cuprous chloride to a saturated solution of the hydrochloride of paratoluidine, the author observed the formation of a crystalline double salt, which dissolved on warming. Orthotoluidine, by the same treatment with cuprous chloride, yielded orthochlorotoluene. In this case the yield is small, orthocresol being the chief product. Orthoamidophenol gave orthochlorophenol. From paraphenylenediamine, paradichlorobenzene was prepared; and from metaphenylenediamine the corresponding dichlorobenzene. To obtain bromobenzene from aniline, in place of cuprous chloride, a mixture of crystallised copper sulphate, potassium bromide, sulphuric acid, and copper turnings were employed, and heated until nearly colourless; the aniline added, again heated, and sodium nitrite solution dropped in. In substituting the amido by the cyanogen group, a solution of the cyanide of copper is first prepared by adding potassium cyanide to copper sulphate solution, heating until the first precipitate is redissolved. A solution of diazobenzenechloride is now added slowly, and the mixture distilled; the oily distillate extracted with ether, washed with caustic soda and dilute sulphuric acid and fractionated.—J. B. C.

Improvements in the Preparation of Halogen Derivatives of Tetramethyldiamidobenzophenone and Analogous Ketone Bases. John Henry Johnson. A Communication from Heinrich Caro, chemist to the Badische-Anilin und Soda-Fabrik, Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 4850, March 13, 1884.

THE ketone bases are treated with trichloride or oxychloride of phosphorus, or the corresponding bromine compounds, when the oxygen of the carbonyl group becomes replaced by Cl or Br. The halogen derivatives thus obtained are unstable blue colours, which readily undergo condensation in the presence of amines, giving rise to triphenyl-methane derivatives, or allied bodies. The following is given as a typical illustration of the process:—Dry powdered tetramethyldiamidobenzophenone is mixed with 1½ times its weight of phosphorus trichloride at the ordinary temperature. The replacement of the oxygen by chlorine is indicated by a spontaneous rise of temperature, and by the mixture becoming blue. During the early stage of the reaction the temperature is not allowed to rise above 40° to 50° C., but after several hours heat may be applied in a water bath to complete the reaction. It is not necessary to actually isolate these unstable blue chlorine substitution products, but the reaction can be performed in the presence of another amine, so as to produce the desired phenyl-methane derivative.—R. M.

The Production of Violet and Blue Colouring Matters of the Rosaniline Series by Treating Aromatic Amines with Alkylised Amido-Derivatives of Benzoyl Chloride and of Benzophenone. Charles Denton Abel. A Communication from the Farbwerke, vorm. Meister, Lucius und Brüning, Höchst-on-the-Maine, Germany. Eng. Pat. 4961, March 15, 1884.

THE inventors give as an illustration of the process claimed the following series of reactions: Dimethylamidobenzoic acid (Michler, Ber. ix. 401) is by means of PCl_5 converted into dimethylamidobenzoylchloride—

$$CO \begin{cases} C_6H_4N(CH_3)_2 \\ Cl \end{cases}$$

and the latter mixed with an excess of diethylaniline and aluminium chloride and gently heated when a mixed ketone is first formed, having the formula—

$$CO \begin{cases} C_6H_4N(CH_3)_2 \\ C_6H_4N(C_2H_5)_2 \end{cases}$$

This ketone (Michler, Ber. ix. 716), in the presence of aluminium chloride, condenses with a second molecule of diethylaniline, producing dimethyltetrethyltriamidotriphenylmethane:—

$$C \begin{cases} C_6H_4N(CH_3)_2 \\ C_6H_4N(C_2H_5)_2 \\ C_6H_4N(C_2H_5)_2.Cl \end{cases}$$

(See also O. Fischer, Ber. xii. 1690.) The latter is a blue violet colouring matter, and a very blue shade is obtained by employing methyldiphenylamine instead of diethylaniline. The alkylised amidobenzophenones described can be isolated and condensed with other tertiary aromatic amines by means of aluminium chloride, carbonyl chloride, phosphorus trichloride and pentachloride, anhydrous ferric chloride, zinc chloride,

etc. In the presence of sulphuric acid, condensation occurs with secondary amines. Thus the above ketone, with methyldiphenylamine, yields a very blue violet colouring matter of the formula—

$$C\begin{cases} C_6H_4N.CH_3.C_6H_5 \\ C_6H_4N(CH_3)_2 \\ C_6H_4N(C_2H_5)_2.Cl \end{cases}$$

It is of course necessary to isolate the ketones, unless the colouring matter is to contain different radicles. A list of the secondary and tertiary amines, ketones, etc., employed in the syntheses is given in the specification. —R. M.

Improvements in the Manufacture of Colouring Matters of the Rosaniline and Pararosaniline Series. Frank Wirth. A Communication from Emil Erlenmeyer, Frankfort-on-the-Maine, Germany. Eng. Pat. 5021, March 17, 1884.

ACCORDING to this invention, red, violet, and blue colouring matters of the rosaniline series are produced by oxidising mixtures of methylated amines with primary, secondary and tertiary aromatic amines. Various mixtures of methyl-violet and aniline, or "mineral green," aniline and arsenic acid are also given. The same materials in different proportions can also be oxidised by means of nitro-benzene in the presence of iron filings. The next section of the patent gives processes for the preparation of violet and blue colouring matters by the oxidation of combinations of methylated amines with secondary and tertiary aromatic amines. Thus, for the preparation of colours from dimethylaniline and diphenylamine, the two bases are gently heated with acetic acid, cupric sulphate and common salt for twenty-four hours to 60° to 80° C. with free access of air. Other variations in the process are given, such as the use of a methyl-violet and diphenylamine or benzyl, methyl or ethyldiphenylamine, etc. By heating a mixture of 170 parts diphenylamine, 140 parts methylphenylnitrosamine and 150 parts zinc chloride, or 107 parts monomethylaniline or 60 parts dimethylaniline, 200 parts diphenylnitrosamine and 150 parts zinc chloride to 100° C. for about twelve hours, a blue colouring matter is produced.—R. M.

Improvements in the Manufacture of Violet Colouring Matters. Herbert J. Haddan. Communicated by Dr. Hugo Hassenkamp and the Farbenfabriken vorm. F. Bayer & Co., Elberfeld, Prussia. Eng. Pat. 7645, May 13, 1884.

THE object of this invention is to obtain an economical production of sulphonated benzyl violets. Instead of sulphonating the colouring matter directly as heretofore, the leuco-base is acted upon, the ordinary methyl-violet being first reduced and then benzylated; or the benzylated violet is reduced and then sulphonated; the sulpho-acid of the leuco-base being converted into colour by oxidation. The reduction of the violets to the corresponding leuco-bases is effected by means of zinc dust in acetic acid solution, or by any other method; and the leuco-base is benzylated by treating in a closed vessel with benzyl chloride and sodium hydroxide. The benzylated leuco-bases are sulphonated by hot sulphuric acid of 66° Bé., or by cold fuming acid, mono-, di-, or trisulphonic acids being produced according to the number of benzyl groups present. The products are sent into the market as calcium or sodium salts. —R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Treating Cotton and Woollen Rags and Fibres. John Illingworth. Amended Specification. Eng. Pat. 2796, June 5, 1883.

THE inventor claims the use of a rotary cage, working within a heated flue or boiler, for the purpose of drying fibrous materials that have been previously soaked in dilute sulphuric acid, the object being to disintegrate the vegetable portion. After drying, the speed of the rotary cage is increased, thus causing it to act as a willow. When thoroughly dusted, an alkaline mixture of soda, chalk, or lime is introduced for the purpose of neutralising the acid remaining in the fibre, after which it is again dried. The drying is assisted by means of an exhaust fan.—E. J. B.

Waterproofing Textile and other Fabrics. John Smith Sweet. Eng. Pat. 133, January 1, 1884.

THE fabrics are saturated with a composition consisting of linseed oil, soft soap, patent dryers, olive oil, and oil of caraway. They are then exposed to the air or in heated rooms, and finally calendered.—E. J. B.

An Improved Method of and Apparatus for Treating Fibres, Rags, and Woven Fabrics. John Illingworth. Eng. Pat. 493, January 3, 1884.

THE object of this invention is to destroy the vegetable portion of mixed rags or fabrics. This is done by means of hot hydrochloric acid gas dried by passing through sulphuric acid. Instead of sulphuric acid, sulphate of chalsium (*sic.*) may be employed. When the action is completed, a fine spray of ammonia solution is introduced for the purpose of neutralising any remaining acid. The operations are conducted in a revolving cage furnished with spikes for the purpose of thoroughly stirring the material. The specification is accompanied by elaborate drawings of the apparatus employed.—E. J. B.

Improvements in the Treatment of Fibrous Materials for the Preservation thereof. Heinrich Wilhelm Knemeyer. Eng. Pat. 3790, February 22, 1884.

THE improvements consist in coating yarn or fabric with basic copper or zinc carbonate by alternately soaking in a solution of copper or zinc sulphate and carbonate of soda. The method has this advantage over the old methods of impregnation with copper sulphate or copper or zinc soaps—viz., that the preservative is not so readily removed.—E. J. B.

Improvements in the Treatment of Vegetable Fibres, and of Yarns and Fabrics Manufactured therefrom. Dr. August Prinz and Emil Quellmalz. Eng. Pat. 5838, April 2, 1884.

THIS invention relates to the treatment of such fibrous substances as nettle fibre, rhea, hemp, flax, and particularly jute. The process consists in macerating the fibre in a cold dilute solution of chloride of lime for 20 to 50 hours. It is then heated under pressure with an alkaline lye containing a proportion of benzene, naphtha, or bisulphide of carbon. The inventors claim that by this process such fibres as the above mentioned can be entirely freed from extraneous substances, and can be rendered fit for weaving into the finest fabrics. —E. J. B.

Improvements in the Manufacture of Waterproof or Impermeable Fabrics. Sydney Pitt. Communicated by the Company for Manufacturing Waterproof Fabrics, St. Petersburg. Eng. Pat. 10,600, July 25, 1884.

THE fabric is first washed in a weak solution of soda, then with water, and afterwards dried. It is then immersed in sulphuric acid of from 54° to 56° Beaumé for 40 to 80 seconds, after which it is rinsed in cold water and placed in a bath of weak ammonia for eight hours. After this preliminary treatment the fabric whilst still wet is soaked in the following solution:—

3000 to 4000 parts of water	526 parts	Colophony
	180 „	Soda crystals
	90 „	Green soap
	195 „	Silicate of potash
	9 „	Caustic potash

After remaining in this solution for three hours it is placed for an hour in a bath containing five per cent. of

sulphate of alumina, after which it is rinsed and dried. Finally, the fabric is subjected to the action of rotating brushes covered with a mixture of paraffin, wax, and colophony. With the exception of the sulphuric acid treatment, the above process can be applied to woollen goods.—E. J. B.

The Disintegration of Vegetable Tissues. John Adams Southmayd. Complete Specification. Eng. Pat. 11,877, September 2, 1884.

THIS invention consists in a method of reducing vegetable substances to the state of pulp by first boiling with an alkaline lye and then suddenly ejecting the mass under the existing steam pressure of 75lb. to 150lb. The inventor claims a considerable saving of chemicals. By first washing with water, and then introducing a solution of chlorine in water, the pulp may be bleached in the boiler. The mass of white pulp may then be ejected as above. The boiler, which is of a peculiar construction, is conical in shape. A drawing accompanies the specification.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Action of Bisulphites upon Chlorates. Dingl. Polyt. Journ. 1884, 254, 226.

SOME observations on the reducing action of sulphurous acid and its acid salts are published by M. Prud'homme in the Bulletin de Mulhouse, 1884, p. 436. Free sulphurous acid yields with chloric acid, sulphuric and hydrochloric acids, whilst the alkaline bisulphites reduce chlorates only partially, as represented in the following equations: $NaClO_3 + NaHSO_3 = HClO_2 + Na_2SO_4$ and $NaClO_3 + 2NaHSO_3 = HClO + Na_2SO_4 + NaHSO_4$. The sodium bisulphate formed in the latter reaction may again act upon the bisulphite and set sulphurous acid free, which in its turn will exert a reducing action. By pouring a 30° sodium bisulphite solution into a concentrated solution of sodium chlorate (about 100 grammes to the litre) a violent reaction takes place, especially when the chlorate solution is warm. A strong odour of chlorine oxidation products and sulphurous acid is developed while the reaction is going on. The solution decolourises indigo and other colouring matters, and converts cellulose into oxycellulose, which can readily be recognised by its affinity for methylene blue, etc. When mixed with aniline salts it forms aniline black, proving the correctness of Rosenstiehl's theory of the formation of aniline black by various oxidation products of chlorine. When chlorates and bisulphites act upon each other in the presence of alcohol, among other products chlorinated ethers are formed.—F. M.

Aniline Black. L. Liechti and W. Suida. Dingl. Polyt. Journ. 254 [6], 265, 1884.

TAKING advantage of the inter-molecular change which chlorate of aniline suffers when exposed to the atmosphere in the crystalline state, the authors have prepared aniline black without the aid of a metallic salt. The aniline chlorate was prepared by adding moist, recently precipitated aniline sulphate to a saturated solution of barium chlorate, and after some time decanting the clear neutral solution from precipitated barium sulphate. The solution of chlorate of aniline yields after a time, colourless prisms of that salt, which by contact with atmospheric air are directly converted into aniline black ("Emeraldine"). The application of heat causes the change to be of an explosive nature. No alteration of crystalline form takes place, the crystals of aniline chlorate simply become bluish black. The authors have studied the behaviour of the pure aniline chlorate solution under varying circumstances, and find: (1) That it can be boiled without change; (2) that the addition of hydrochloric acid with subsequent heating brings about a copious formation of emeraldine; (3) that dilute sulphuric acid causes the precipitation of very little emeraldine; (4) ferric chloride and (5) vanadium chloride act like hydrochloric acid; (6) the solution warmed with cupric sulphate, simply becomes brown; (7) tartaric and acetic acids are without action; (8) warming with dilute nitric acid effects little alteration of the solution, but on the subsequent addition of ferric chloride there is thrown down a precipitate of blue passing to green colour; (9) dilute chromic acid mixture brings about a copious formation of black; (10) the solution boiled with ammonium chloride remains unaltered but subsequent addition of cupric sulphate causes a black precipitation; (11) boiled with ammonium vanadate, the solution does not yield emeraldine; (12) hydrochloric acid in the cold causes the precipitation of emeraldine from a brown solution, which if warmed becomes reddish voilet and yields more emeraldine. The crystals of aniline black yield, after treatment with hydrochloric acid, alcohol, ether and dilute potash solution, pure emeraldine corresponding in its properties with the aniline black described by Nietzki and giving on analysis, numbers which lead to the formula $C_{18}H_{15}N_3HCl$. The authors found the more abundant products of the distillation of emeraldine with zinc dust to be diphenylphenylenediamine, diphenylamine, diamidodiphenylamine, the less abundant, phenylenediamine, aniline and ammonia. The correctness of Nietzki's view that the black is to be regarded as a hydrochloride of the base $C_{18}H_{15}N_3$ does not receive confirmation at the authors' hands. They have found that chlorine is present in all the salts derived from emeraldine and that this chlorine cannot be eliminated by the action of oxide of silver. They therefore incline to the view that emeraldine is a chloro-substitution product of the base $C_{18}H_{15}N_3$. The correctness of this view derives confimation from the facts that the chlorates of the heavy metals yield oxides of chlorine when decomposed, and of such, Cl_2O_3 for example is capable of forming chlorinated derivatives of organic bodies. To obtain some explanation as to the formation of aniline black upon the fibre and the part played in the reaction by the usually added metallic compounds the authors made the following experiments. Dissolved aniline chlorate was mixed with dissolved aniline hydrochloride in molecular proportions respectively of 1 : 0, 1 : 1, and 1 : 2. The fabric was padded in these solutions, experiments being made at the same time with similar solutions containing a trace of vanadium chloride. On hanging at from 31° to 35° the fabric containing vanadium rapidly blackened, that free from vanadium underwent no change. On treating the latter with dilute hydrochloric acid, a formation of emeraldine soon took place. Also on heating the vanadium free fabric to about 80° to 90°, a formation of black took place even upon the portions not heated. It would thus appear that for the formation of the black upon the fibre, the chloric acid must be in a liberated condition. The metals employed in the production of aniline black are, according to Rosenstiehl, those the chlorates of which are easily decomposed at comparatively low temperatures; hence it has been considered that these simply act by supplying lower oxides of chlorine. Liechti and Suida consider that the presence of free hydrochloric acid is essential to the reaction. If a colour containing aniline hydrochloride, potassium chlorate and cupric chloride be taken, the two latter bodies are mutually decomposed. The chlorate of copper reacts with the aniline salt as may be expressed by the equation:

$$\text{(I.)}\ 6C_6H_5NH_2.HCl + CuCl_2O_6 = 2C_{18}H_{16}ClN_3 + 4HCl + CuCl_2 + 6H_2O.$$

The hydrochloric acid thus set free, is able in the presence of potassium chlorate to continue the oxidation which the salt of vanadium or copper started, thus:

$$\text{(II.)}\ 3C_6H_5NH_2.HCl + KClO_3 + HCl = KCl + 3HCl + 3H_2O + C_{18}H_{16}ClN_3.$$

A small amount of copper or vanadium is therefore able to bring about the formation of a comparatively large quantity of the black. From equation II. it would appear that a portion of the aniline employed might be

combined with a feeble acid, in order to decrease to some extent the tendering action of the hydrochloric acid upon the fibre.—W. D. B.

Iron Mordants in Silk Dyeing. Dingl. Polyt. Journ. 254, 437.

THE iron (ferric or "red") mordants used in silk dyeing are prepared by oxidising ferrous sulphate by means of nitric acid. The product is usually a basic ferric sulphate containing a certain small proportion of ferrous salt, and sometimes some nitric acid. The influence of these occasional constituents has been investigated by L. Liechti and W. Suida (Mitth. Techn. Gew., Wien, 1884, 55). These authors prepared mordants of the following typical composition respectively:—(1) $Fe_2(SO_4)_{2.5}OH$ of 30° B.; (2) $Fe_2(SO_4)_2NO_3.OH$ of 30·5° B.; and (3) $Fe_2(SO_4)_2(OH)_2$ of 31° B. Weighed quantities of silk were allowed to lie in these solutions under the usual conditions, and after further treatment by the ordinary method the quantity of iron fixed in the fibre was determined. The most favourable result obtained was with (3), 12 per cent. of Fe_2O_3 being fixed, whereas from (1) only 8 per cent. was taken up by the silk. The weight from (2) was 11 per cent., a result very little inferior to that obtained with (3), notwithstanding that the latter was the more basic. Most of the commercial products examined by the authors approximated in composition to (1), but contained also a small but varying proportion of nitric acid. One of the standard products used at Crefeld had the following composition:—Total iron = 11·5 per cent., as ferrous salt 0·5 per cent., sulphuric acid (SO_4) = 27·2 per cent., corresponding to the formula $Fe_2(SO_4)_2$. With respect to the influence of ferrous salt upon the dissociation phenomena of the mordant the authors find that in regard to the dissociation produced by water alone it is considerably less in presence of ferrous salt, whereas, strange to say, the dissociation caused by the silk fibre is not in any way affected. The question therefore of the employment of mordants containing residual ferrous salt is still an open one.—C. F. C.

Potassio-Antimony Oxalate as Tartar Emetic Substitute. Dingl. Polyt. Journ. 255 [3], 122.

FOR fibres of vegetable origin tannin has always been employed as the most efficacious mordant for artificial colouring matters. As a type of the kind of mixings to be employed as a means of conveying aniline colouring matters on to cotton fabrics we have always had a suitably thickened mixture of colouring matter (salt of rosaniline or substituted rosaniline) with tannic acid and acetic acid added to avoid premature precipitation. Such lakes were, however, soon found to be of very limited fastness, to lose considerable quantities of colour not only on soaping, but even on mere washing and steaming. The consequence was loss, and what was still worse, degradation of the whites and of the colours printed along with the above. It was impossible—*e.g.*, to employ an alizarine steam red together with methylene blue fixed only with tannin. The idea developed then to fix the tannin not only by a colouring matter, but also by a metallic oxide, and Thomas Brooks, of Manchester, made the proposal to accomplish this end by means of antimony, and to apply the same as tartar emetic. This salt was chosen on account of being dissolved by water *in toto—i.e.*, without the formation of insoluble compounds, and also because whilst fixing the tannates it exercises no further and degrading action on the other colours. The Société Industrielle de Mulhouse in 1881 awarded a medal to Mr. Thos. Brooks for his successful improvement. An objection was the cost, the said salt being one of the dearest antimonial preparations. Moreover, tartar-emetic cannot be replaced by such antimony salt as the trichloride since the same yields with water an insoluble basic salt and free acid. Of the attempts made to substitute cheaper metallic salts for tartar-emetic, H. Schmid's proposal to employ acetate of zinc met with a certain amount of success in practice (Chemiker Zeitung, 1881, p. 949). Acetate of zinc acts well when it is simply the intention to fix the tannin, and is employed in several print works. In the case of more complicated patterns, such as when it is desired to fix aniline colours along with alizarin red, antimony takes the first place, and the introduction into commerce of the cheaper oxalate instead of the tartarate was a step in the right direction. The double oxalate had indeed been known for some time, but was sold at a price out of proportion to its contents in antimony. Tartar emetic contains 43·7 per cent. of Sb_2O_3, and $Sb(C_2O_4K)_3.6(H_2O)$ only 23·67 per cent. Sb_2O_3. Hence in making up an antimonial bath we require double the quantity of the latter salt. At the present time the salt in question is sold at a price proportionate to its percentage of Sb, and to the price of the organic acid contained in the salt. If solutions of the double oxalate be much diluted a slight deposit of insoluble basic salts is observed, but does not appear to cause any disturbance. This property is indeed of use in making printing trials on the small scale. Thorough washing is essential in order to remove any basic salt which might attract fatty acids during the soaping process, and then degrade the whites by means of waste colouring matter.—H. A. R.

Phenylhydrazine as a Discharge on Bistre. Dingl. Polyt. Journ. 255 [3], p. 128.

G. SCHAEFFER, in *Bulletin de Mulhouse*, 1884, p. 57, states that phenylhydrazine, owing to its reducing properties, may be employed in a similar manner to hydroxylamine (see *Bull. de Mulhouse*, 1883, 250, p. 380) to produce white patterns on a ground of manganese or bistre brown.—H. A. R.

Improvements Applicable to the Dyeing of Black Colours upon Cotton and other Vegetable Fibres. Joseph Knowles Kaye. Eng. Pat. 2372, January 30, 1884.

THE material is dyed in a bath containing logwood extract, tannic acid, and carbonate of copper. It is removed from the bath, allowed to stand for a few hours, and then saddened by immersion in a cold weak solution of iron liquor. Such a method gives a finer and more durable black than has hitherto been obtained.—E. J. B.

Improvements in Dyeing Wool or other Similar Animal Fibre, and in Apparatus Employed therein. Charles Holliday and Ernest William Hirst. Eng. Pat. 2837, February 6, 1884.

THE improvement consists in dyeing wool in a chamber of special construction. The dyeing or mordanting solution enters at the bottom of the chamber, and flowing upwards by a central tube is distributed evenly over the material to be dyed, which is placed on a series of perforated plates. The chamber is connected with an air-pump, and is furnished with a steam coil for heating. The inventors claim:—"The method and combination or arrangement of apparatus for dyeing wool and other similar animal fibre, whereby the air or vapour released or generated during the operation is enabled to pass off without passing through the fibres, in order to prevent deleterious effects upon the fibres from ebullition or disturbance thereof, and to obtain better distribution of liquid passing there through." By using such an apparatus a considerable economy of dye is effected, particularly in the case of indigo.—E. J. B.

Manufacture of Mordants and Colouring Matters from Glucosides, Tannin and Bitter Principles. W. L. Wise. A Communication from C. H. Knoop. Eng. Pat. 4480, March 6, 1884.

THIS relates to the production, by the action of oxidising agents, of colouring matters which are soluble in water and precipitated by alkalis, and of which the less highly oxidised may be used as mordants, while the more oxidised give fast colours without the use of separate mordants on spun and woven fabrics, either animal or vegetable. As an example, 20kilos. of extract of Brazilwood are dissolved in boiling water, to which is added a little nitric or hydrochloric to precipitate the

resin, and the clear brazilin solution is removed, and a solution of 5kilos. of permanganate of potash is mixed with it with constant agitation. The resulting precipitate is filtered off, washed and dissolved in nitric, hydrochloric, sulphuric, or oxalic acids, and if necessary boiled. After cooling, it is neutralised with ammonium carbonate, and forms a reddish-violet colouring matter in the form of a paste. Many other chemicals may be substituted for permanganate of potash, with varying results. Tetrachloride of tin, chlorate and chromate of potash, and salts of mercury, chromium arsenic, manganese, etc., and frangulin, maclurin, quercitrin, carthamin, hæmatin and catechin are spoken of as suitable materials.

—H. R. P.

Improvements in Bleaching Fibrous Materials, Fabrics and Paper-pulp of Vegetable Origin. Robert and Alexander Watson Townsend, of Port Dundas, Glasgow, manufacturing chemists. Eng. Pat. 12,732, September 24, 1884.

The object of this invention is to shorten the time required, obtain improved results as regards whitening action, and avoid injury to the materials operated on when bleaching fibrous material, fabrics or paper-pulp, of vegetable origin. The invention consists in the employment of one or more of the oxychlorides of magnesium, barium, strontium, potassium or sodium. For bleaching jute, esparto, wood-pulp, cane-pulp or other vegetable material, the inventors propose to employ oxychloride of magnesium in solution, and of the strength of about 11° T., and claim that one gallon of the said solution will bleach about five pounds of the materials when these are in the condition in which they are ordinarily subjected to a bleaching process. "The bleaching action will in most cases take place on steeping the materials in the solution at the ordinary temperature for a suitable length of time, but the action may be increased or hastened by raising the temperature." No acid is added to the solution, nor do the materials require to be "soured" or treated with dilute acid. The "improved process effectively, and without injuring the fibre, bleaches jute and other vegetable materials of kinds which cannot be satisfactorily treated by ordinary bleaching without injury to the fibre." The solution is prepared either by dissolving the salt previously prepared in any known way, or else by the double decomposition of bleaching powder solution and the solution of the sulphate of magnesia, or the sulphate of one or more of the bases hereinbefore named.

—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Oxides of Nitrogen. Prof. W. Ramsay and J. Tudor Cundall. Proc. Chem. Soc. [3], 22-23.

In this research it is shown—

1. That the green or blue liquid obtained by the action of arsenious anhydride on nitric acid consists of a mixture of nitrous anhydride and nitric peroxide, in proportions depending on the strength of the nitric acid and the temperature at which the volatile liquid is condensed.

2. That if a dehydrating agent, such as sulphuric acid, be present in sufficient quantity the distillate consists of pure peroxide, and that this process is by far the most convenient one for the preparation of the peroxide.

3. That if oxygen be passed over the blue liquid, the vapours condensed in a freezing mixture are still blue or green; a great excess of oxygen is necessary to effect conversion from nitrous anhydride into peroxide.

4. That when excess of nitric oxide is passed along with the peroxide into a cooled bulb, the trioxide is produced, the amount of trioxide depending on the temperature of the condenser.

5. The vapour-density of a liquid of a deep-blue colour, containing about 30 per cent. of trioxide and 70 per cent. of peroxide, shows that the trioxide cannot exist in the gaseous state, but at once dissociates into nitric oxide and peroxide on changing to gas. The theoretical vapour-density of such a mixture was calculated from a formula deduced from the second law of thermodynamics by I. Willard Gibbs, which shows the relations between temperature, pressure, and vapour-density of the mixture of NO_2 and N_2O_4 in the gaseous peroxide; and it was found that the vapour-densities of a mixture of $(NO_2+N_2O_4)$, (partly present in the original liquid as peroxide, partly formed by the decomposition of the N_2O_3 present into NO and $(NO_2+N_2O_4)$), with the NO produced by the decomposition of the N_2O_3, calculated by means of Gibbs' formula, are identical, within limits of experimental error, with those obtained by direct experiment.

6. The presence or absence of moisture does not appear to affect the reaction between NO and O_2.

7. It is probable that N_2O_3 undergoes dissociation with rise of temperature, even while liquid.—W. S.

New Apparatus for the Production of Ammonia Soda. Dingl. Polyt. Journ. 254 (12), p. 488.

The Société Anonyme des Produits Chimiques de l'Est, following the patent of D. Maguin, of Nancy (D.R.P., Kl. 75, No. 28,761, of December 11, 1883), seek to obtain a more complete action of the carbonic acid on the ammoniacal liquors by causing the latter to flow uninterruptedly from a reservoir R (Fig. 1), through a pipe t, to fill the series of vessels B, C, etc. to a certain height, the liquor passing from one vessel to the next through the overflow pipes b, c, d, etc., and being at last run off from the last vessel G by opening the cock h. At the same time, brine flows into the vessel A from the washing apparatus w, which is fed from S, and this absorbs the ammonia from the gases before their escape from the apparatus. This brine mixes in the vessel B with the ammoniacal liquor, and its flow is regulated so as to always form an appropriate percentage of the ammonia contained in the mixture. The carbonic acid is let in with a certain velocity, and, traversing the vessels in a direction opposite to that of the ammonia liquor, passes through the washing apparatus w, and escapes through the pipe n into the air. Whilst the pure carbonic acid is introduced by the pipe k, the impure carbonic acid enters through the pipe K, so that the latter first mixes with the pure gas after this has passed from F into the next vessel E. In every vessel, the gas first passes through an inverted funnel, the larger circumference of which is serrated, and rises up through the liquor, which it dashes about in the upper part filled with gas, and then passes over into the next vessel in the series. For the recovery of the ammonia after the separation of the precipitated sodium bicarbonate, the whole of the free ammonia and carbonic acid is driven off in the vessels A to C (Fig. 2), and the decomposition of the ammonium chloride, by means of lime, is effected in the vessels D and E. While the apparatus is working, the clear liquor flows uninterruptedly through the pipe t into the collecting vessel M, then through an overflow pipe a to the distilling vessel A, and likewise through b and c into the stills B and C. The liquid coming over from this last vessel C into the vessel D contains no more carbonate of ammonia, but only ammonium chloride. Milk of lime is therefore constantly pumped into the vessel D through the pipe s, and reacts upon the liquor likewise continually flowing in, and sets free ammonia. As soon as the liquor in the vessel D has reached a certain height, a portion is allowed to flow over into E by opening the cock h. Both vessels D and E are provided with inverted troughs with toothed edges, in order to favour the disengagement of the ammonia. The steam entering by the pipe r at the bottom of E, drives out the last traces of ammonia still in the liquid, and the steam with the ammonia flow through the pipe e into the vessel D, where, after becoming considerably enriched with ammonia in passing through the liquor, it then enters by the pipe f into the inner funnel x of the vessel C, until finally it arrives along with ammonia and carbonic acid by the pipe z in the collecting vessel M, and further into the pipes m, which are cooled in a trough containing water. The steam becomes for the greater part condensed here, and flows

back in the somewhat inclined pipes *m*, into the collecting vessel, from which it reaches the apparatus again through the overflow pipe *a*. The mixture of ammonia

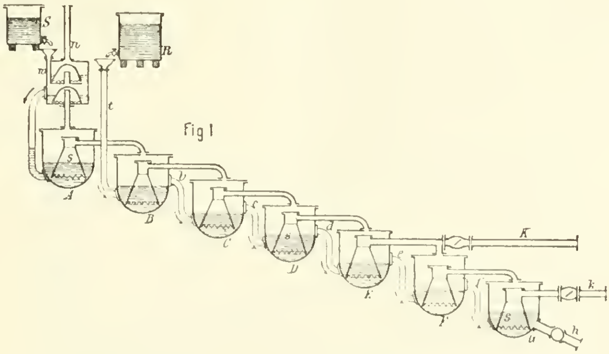


Fig 1

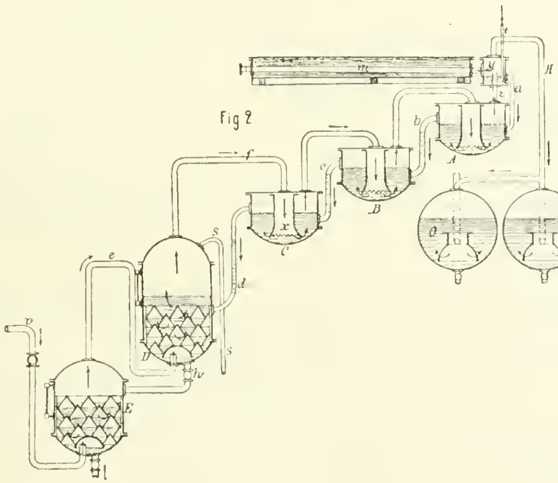


Fig 2

and carbonic acid gases, with only a small quantity of water vapour, flows over through the pipe H into the vessels O and P, by the liquor in which it becomes absorbed.—G. H. B.

Process for the Recovery of Sulphur from Soda Waste. Dingl. Polyt. Journ. 255, 206, 1885.

H. Grouven (Ger. Pat. 29,848, May 30, 1884) mixes alkali waste with 10 per cent. of sawdust, and from 10 to 25 per cent. of water, according as the waste is new or old, in a kneading machine, and then moulds the resulting doughy mass into tubes, in an ordinary press. The most suitable length for these tubes is 250mm., the external diameter being 45mm., and the internal 20mm. The tubes are exposed to the action of the air, under cover, for about two days, when they become hard and brittle. They are next heated in retorts, along with steam. The carbonic oxide and hydrogen generated throughout the mass, completely reduce all the oxides of sulphur contained in the waste. Almost all the sulphur is converted into the form of sulphide of calcium; and this, at a high temperature in the presence of steam, yields sulphuretted hydrogen and lime. The chief object in using sawdust is to give great porosity to the moulded cylinders, this being essential to the complete decomposition of the mass. When the proper temperature has been maintained, practically, all the sulphur is removed in three hours; and the residue left in the retorts is yellow coloured, and on boiling with dilute hydrochloric acid, neither carbonic acid, nor sulphuretted hydrogen, nor sulphurous acid, is evolved. On fusing with nitrate of potash, only from one to two per cent. of sulphuric acid is obtained, and this existed principally as sulphate of lime. This residue contains from 85 to 90 per cent. of quicklime, and can be used for mortar making.—W. M.

Leplay's Process for Preparation of Barium and Strontium Hydrates. Dingl. Polyt. Journ. 254, 436.

This process (Ger. Pat. 28,757, 1883), consists essentially in treating the carbonates with steam superheated to a temperature higher than the melting point of the hydrates. The details are as follows:—The carbonate is

introduced into the iron pots E (Fig. 1), which, having been brought to a low red heat, are successively removed, and their contents transferred to the retort A. Superheated steam is then introduced into A, through d; the carbonate is decomposed, and the molten hydrate flows by way of n into B. t is a tube containing barium or strontium hydrate, by the melting of which the attainment of the requisite temperature, by the steam

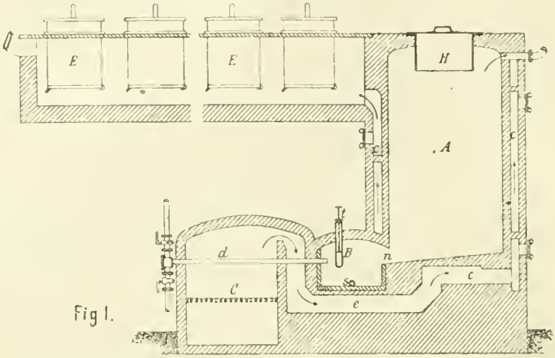
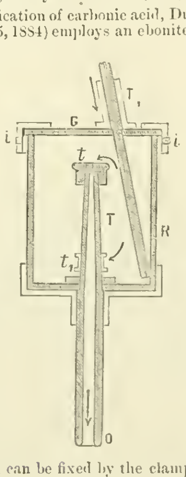


Fig 1.

issuing through d, is ascertained. The molten hydrate is run off from B, through S, into iron moulds. A supplementary patent (29,153, 1884), contains modifications and improvements in detail. It is found that the carbonates are best prepared by working them into a paste with 30 to 40 per cent. of a weak caustic lye—the presence of the alkaline hydrate facilitates the separation of the molten earth-hydrate from the undecomposed carbonate—which is then made into balls or hollow cylinders, which require to be suddenly heated to a high temperature in order that they may not fall to pieces with the loss of water.—C. F. C.

Apparatus for the Preparation of Solid Carbonic Acid. Dingl. Polyt. Journ. 255, 201, 1885.

FOR the solidification of carbonic acid, Ducretet (*Comptes Rendus*, 99, 235, 1884) employs an ebonite cylinder R, the



cover of which can be fixed by the clamps S. The pipe T passes through the cover and reaches almost to the bottom of the vessel. The liquid carbonic acid enters by this pipe, and solidifies as it strikes against the bottom of the cylinder; while the gaseous carbonic acid, and any air which has been carried over escape by the pipe o, the openings of which, at t and t, are covered with fine wire gauze. The top G is taken off when it is desired to remove the solid carbonic acid. This apparatus is said to produce a much larger quantity than Thilorier's system.—W. M.

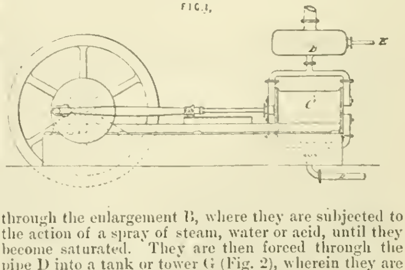
Preparation of Sulphuric Acid from Gypsum. Dingl. Polyt. Journ. 255 [2], 87.

BY heating a mixture or two parts of calcium sulphate with one of ferric oxide, to a bright red heat, *Scheurer Kestner* obtains all the sulphur as sulphuric anhydride. Towards the end of the process, sulphurous acid and oxygen are formed, but this decomposition is considerably retarded by adding either calcium fluoride or chloride to the mixture. A similar reaction takes place at a lower temperature with the sulphates of other bibasic metals, such as lead or magnesium.—S. R.

Improvements in the Method of and Apparatus for Manufacturing Sulphuric Acid. M. Finch, W. J. & S. Willoughby, Plymouth. Eng. Pat. 3086, February 11, 1884.

THE sulphurous and nitrous gases from the pyrites or sulphur burners, after passing through a Glover tower, are conducted into a pump, or any other contrivance suitable for drawing and forcing the same. Before entering the barrel C (Fig. 1) of the pump, they are made to pass

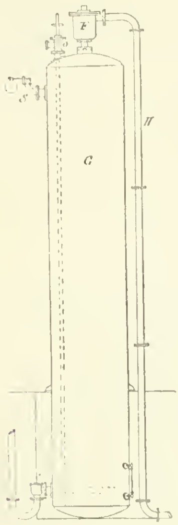
FIG. 1.



through the enlargement B, where they are subjected to the action of a spray of steam, water or acid, until they become saturated. They are then forced through the pipe D into a tank or tower G (Fig. 2), wherein they are compressed to promote the oxidation of the sulphurous gas. Sulphuric acid is formed, which falls to the bottom, whence it is drawn off by a valve O. The tower is provided at the top with a valve F, so constructed, that when the gases attain a certain pressure, the uncondensed

portion thereof may escape through the same, and pass into another tower of similar construction; and this is repeated until the desired conversion into sulphuric acid

FIG 2



has been effected. From the last tower, the gases, deprived of sulphurous acid, escape into a Gay-Lussac column for the absorption of nitrous gases.—S. H.

Improvements in the Manufacture of Soda and Chlorine. Charles Wigg, Liverpool, and John Waller Pratt, Runcorn. Eng. Pat. 3673, February 21, 1884.

The object of this invention is to treat the residual ammonium chloride liquors of the ammonia soda process in such a manner as to obtain, not only all ammonia, but also all the chlorine, in a condition suitable for the manufacture of more soda, and of bleaching powder. For this purpose the ammonium chloride solution is boiled in a closed boiler, until all the free ammonia and ammonium carbonate which it contains has been volatilised. It is then evaporated, either to complete dryness, or until crystals of ammonium chloride and sodium chloride separate out. The latter can be removed, if found detrimental. The solid ammonium chloride is then mixed with finely ground calcium carbonate, in equivalent proportion. The mixture is transferred to a hemispherical pan, heated from beneath, and provided with a tight-fitting, cast-iron hood or dome, resting on its upper rim. On heat being applied, sesquicarbonate of ammonia is volatilised and sublimed to the roof or dome of the pan, to which it adheres. If the dome is maintained at a high temperature, the condensation of the ammonia salt is prevented, and it can be directly passed into brine for the manufacture of soda ash. The residue in the pan consists of a loose, porous mass of calcium chloride, and while it remains hot in the pan, the top of the pan containing the sublimed ammonium carbonate, is removed, and replaced by another tight-fitting cover, provided with an escape pipe, leading to a condenser. Oil of vitriol is then run on to the contents of the pan, whereby hydrochloric acid is produced; whereas, the calcium sulphate, thus formed, is roasted and converted into plaster of Paris. The sublimed ammonium carbonate is dissolved in strong brine, and another molecule of carbonic acid passed into that solution, causing the formation of sodium bicarbonate, thus:—

$$(NH_4)_2CO_3+H_2O+CO_2+2NaCl=2NaHCO_3+2NH_4Cl.$$

The ammonium chloride solution re-enters the cycle of the operations. By using calcium carbonate, the expense for generating and pumping one-half of the total carbonic acid needed for the production of carbonate of soda, is saved. Instead of using calcium carbonate for the decomposition of ammonium chloride, the carbonates of magnesia, baryta and strontia may be also employed. If magnesium carbonate be used, magnesium sulphate—Epsom salts—will be the ultimate product. Barium or strontium carbonate will leave the chlorides of these metals, as residues, in the pan. In place of running oil of vitriol on the chlorides, the latter are dissolved in hot water, filtered and precipitated with sulphuric acid, yielding precipitate of barium or strontium sulphate, and a supernatant solution of hydrochloric acid. The barium sulphate prepared in this way is as "blanc fixe," an article of considerable commercial value, while strontium sulphate is also suitable for many technical applications. —S. H.

Improvements in the Manufacture and Storage of Bichromate of Soda. C. S. Gorman, Ayrshire. Eng. Pat. 4195, March 1, 1884.

250 parts chrome iron ore, 150 chloride of sodium, and 250 hydrated lime, are mixed and furnaced in presence of superheated steam, at a temperature of 1000° to 1600° F. Hydrochloric acid is evolved and condensed, and chromate of soda is formed, which is dissolved in water, the solution evaporated down and treated with sulphuric acid, to form bichromate of soda. The liquid is then allowed to cool, when sodium chloride and sulphate separate out. The solution of bichromate of soda is further evaporated by hot air, and run in the fluid state into metallic drums, or the evaporation may be carried to dryness.—G. H. B.

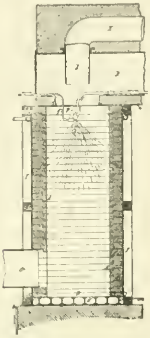
Improvements in the Manufacture of Chromates and Bichromates. W. J. A. Donald, Glasgow. Eng. Pat. 6731, March 13, 1884.

This patent aims at the production of ammonium chromate and bichromate. Chromate of soda, obtained preferably, as described in another patent by the same author, is dissolved and treated with ammonium chloride; sodium chloride is separated by evaporation; and bichromate of ammonia is formed by the addition of a suitable acid, and is obtained in the solid state by evaporation. —G. H. B.

Improvements in the Evaporation and Concentration of Liquids. H. E. Newton, London. Communicated by A. Nobel, Paris. Eng. Pat. 5383, March 24, 1884.

The object of this invention is to provide a rapid method for the evaporation and concentration of liquids. To effect this the liquid is forced in the form of spray into the interior of a tall cylindrical vessel or tower, and at the same time subjected to the action of a current of hot air. The concentrated liquid settles in the lower part of the tower, and can be drawn off at intervals; that portion which is carried over with the air, and the water evaporated, is condensed in suitable vessels. The construction of the apparatus depends in a great measure upon the material operated upon. The illustration shows a form of apparatus suitable for acting upon sulphuric acid. A is a cylindrical tower constructed of lead and lined with a non-corrosive body; it is water jacketed round the exterior I, and on the bottom II. F is an injector formed by the pipe f' conveying the acid, placed at right angles to the pipe f, which admits a blast of hot air at a suitable pressure; the quantity of acid is of course regulated according to the requirements of the evaporation. E is the pipe for conveying the hot air required for the concentration, the temperature of the air being in this case about 500° C. G is the pipe conveying away the air charged with water and acid vapour, which may be

cooled down to a convenient temperature, and then sent through the leaden chambers ; *b* is the pipe which carries off the strong acid after concentration. The lower part of the tower may be advantageously packed with non-corrosive material such as pumice stone, etc. D is a pipe which brings the sulphurous acid gas from the pyrites burners on its way to the acid chambers, and thus the heat of this is utilized for the purpose of concentration.



The claims are (1), the concentration of sulphuric acid and other liquids by injecting them into a tower as described, and passing through the spray a current of heated air ; (2) the utilisation of the heat of the gases from the pyrites or brimstone kilns, alone or in conjunction with air, for concentrating the spray of sulphuric acid, as described and set forth.—C. C. H.

Improvements in the Manufacture of Sulphate of Ammonia. W. A. Meadows, Lancashire. Eng. Pat. 5520, March 27, 1884.

THE absorption of ammonia by dilute sulphuric acid is carried on at a temperature not lower than 100° F. in presence of a small quantity of tar, pitch, oil, fat or like substance, which collects a scum containing the arsenic and iron of the sulphuric acid, and facilitates the removal of these impurities. Pure white crystals of sulphate of ammonia crystallise out.—G. H. B.

Improvements in the Manufacture of Chlorate of Potash. J. Wilson, Berwick-on-Tweed. Eng. Pat. 5975, April 5, 1884.

POTASSIUM chloride and magnesia in suitable proportions are mixed with water and run through a series of vessels where saturation with chlorine is effected. Chlorate of potash crystallises out on evaporation of the resulting solution, and the mother-liquor containing magnesium chloride and some chlorate of potash is further evaporated and roasted in a muffle furnace, whereby chlorine, hydrochloric acid and magnesia are obtained.—G. H. B.

Improvements in Purifying Sulphuric Acid. W. P. Thompson, Liverpool. Communicated by G. Thomson, Quebec, and W. Kemp, Jarrow-on-Tyne. Eng. Pat. 6215, April 10, 1884.

CHAMBER acid is treated with ammonium sulphide, which precipitates the arsenic and antimony present. The acid is then rendered clear by filtration through finely divided lead, and is further concentrated by evaporation, during which the ammonium sulphate present assists in the expulsion of the last traces of oxides of nitrogen, and a very pure acid is the result.—G. H. B.

Improvements in Furnaces for the Manufacture of Sulphate of Soda, or Hydrochloric Acid, or for Roasting, or Calcining Ores, or for Analogous Purposes. W. Black and Thos. Larkin, South Shields. Eng. Pat. 4718, July 16, 1884.

THE substances under treatment are contained in a box-chamber, the cover and bed of which are formed of fire-clay quarls or cast-iron plates. This chamber is provided with a mechanical stirrer, the shaft of which is suitably protected from the fire. Fire-places are arranged on opposite sides of the chamber so that the heated gases from them pass both above and below the said chamber, and thence to the main flue. The charge may be introduced by a suitable channel leading from a decomposing furnace or otherwise, while it is removed by specially constructed doors. A flue leading from some convenient part of the chamber allows of the escape of the evolved gases, which thus never come into contact with the products of combustion coming from the fire-places. —A. R. D.

Improvements in the Production of Alkali Carbonates, and in Apparatus therefor. Peter Jensen, London. A Communication from Adolph Vogt and August Figge, Westerhausen, near Madgeburg. Eng. Pat. 13,590, October 14, 1884.

CHLORIDE of potash or soda and finely divided gypsum or sulphate of magnesia are intimately mixed with caustic magnesia, kneaded moist, and dried. The resulting porous mass is broken into pieces and charged into the sulphating furnace, which consists of a series of superposed cast-iron pipes, so set in brickwork that as little as possible of the weight of each pipe falls on the pipe next below. Superheated steam is driven through the charge, which causes the chlorine to pass away as hydrochloric acid, and the sulphuric acid to combine with the potash. The resulting mixture is transferred to another vertical cast-iron retort raised to redness by external heat, and treated with pre-heated carbonic oxide gas, the sulphate being thus reduced to sulphide. When the reduction is complete, the temperature is allowed to fall, and a mixture of carbonic acid and steam passed through the retort. The sulphide is now converted into carbonate, and the sulphur passes away as sulphuretted hydrogen. The resulting mass is lixiviated cold for the extraction of the carbonates. If a mixture of air and steam instead of steam only is driven through the sulphating retorts, chlorine comes off instead of hydrochloric acid. In this case the inner surface of the retort must be protected by a coating of silicious enamel.—A. R. D.

Improvements in the Process of Manufacturing Permanganates. Theodor Kemp. Eng. Pat. 8218, October 22, 1884.

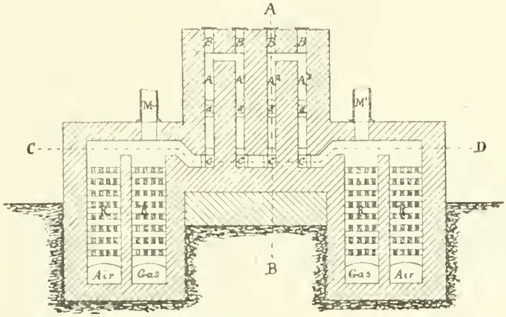
THIS is a process for the transformation of manganates into permanganates by an electric current. The negative electrode is placed in water and the positive in a solution of the manganate in question, the two being separated by a porous wall. The electric current causes the permanganate to separate in the cell containing the positive electrode, while the corresponding hydroxide is formed and hydrogen evolved in the other cell.—A. R. D.

Improvements in and Relating to the Manufacture of Chlorine. Walter Weldon, Burstow, Surrey. Eng. Pat. 9305, June 23, 1884.

THIS invention relates to the apparatus employed in the manufacture of chlorine from a chloride of a metal or mixtures of chlorides, by heating them in a current of air, at the same time excluding the products of combustion of fuel. The operation is performed in a regenerative furnace represented in vertical section by Fig. 1 ; Fig 2 shows a section across the line CD, and Fig. 3, a section across the line AB. A, A^1, A^2 and A^3 are four vertical brick chambers of a small diameter, but with very thick walls. They communicate with each other at their upper and at their lower extremities, whereas the end

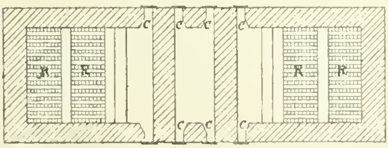
chambers A and A^3 are in direct communication with the regenerators RR. The pipes M and M^1 serve alternately as outlet pipes for the gas given off in order that the current of air may be reversed at will. The whole furnace is encased by iron plates, and protected as much as possible from loss of heat. In using the apparatus, the first step is to heat up the four chambers A, A^1, A^2 and A^3. To this end, gaseous fuel is admitted by one and air to burn it by the other of the two divisions of one

FIG 1.



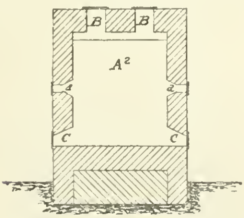
set of regenerators RR. The pipes M and M^1, the discharging doors *c*, the covers B and the sight-holes *d* being all closed, products of combustion then traverse each of the four chambers successively, and finally pass off by the other set of regenerators, from which they are conducted

FIG 2



to a chimney. In order to heat the furnace uniformly, the course of the fire-gases is reversed more or less frequently. When the masses of brickwork of the four chambers have absorbed sufficient heat, the admission of fire-gases is suspended, and the chambers are charged by the openings at B with the substance from which chlorine is to be evolved. One of the pipes M and M^1 is

FIG 3



then opened, and the regenerator on the same side of the apparatus closed, and air only admitted by the other regenerator. The substance will take up heat from the brickwork, and a current of air, which has been previously heated during its passage through the regenerator, will pass over and through the contents of the four chambers, and there will pass off a mixture of gases containing free chlorine. When the charge in A, A^1, etc., has been sufficiently decomposed, the residual solid product is discharged by the doors *c*, and after closing these, as well as the pipes M and M^1 and the sight-holes *d*, the apparatus will be ready to be heated up again for another operation. The products of combustion after having been employed to heat up an apparatus according to this invention should be applied for evaporative purposes, since the chlorides from which the free chlorine is to be evolved will be first obtained in aqueous solution, which solution will require to be evaporated to dryness before being subjected to the action of heat and air in the chambers.—S. H.

Improvements in the Method of and Apparatus for Treating Bisulphate of Soda for Industrial Purposes. Frank Wirth, Frankfort-on-Maine. A Communication from Hermann Herberts, Barmen, Germany. Eng. Pat. 3323, November 10, 1884.

TWO cisterns containing respectively a concentrated solution of bisulphate of soda, and chalk suspended in water, communicate with a lead-lined, boiler-shaped vessel, by pipes fitted with taps, and reaching to the bottom of the latter. The lead-lined vessel is provided with a stirrer, and has also a dome from which one pipe leads away through two calcium chloride washers to a gasholder, and another pipe communicates with a vessel containing carbonic acid under a pressure of six atmospheres. Below is a filter communicating with the lead-lined vessel by a pipe also reaching to the bottom of the latter. A portion of the contents of the two first-named cisterns are run into the mixing vessel and agitated. Carbonic acid is evolved and passes away to the gasholder. When all the free acid is saturated, the carbonic acid under pressure is admitted, and drives the turbid contents of the mixing vessel over on to the filter below. The liquor passing from this is concentrated for the recovery of Glauber's salts.—A. R. D.

Improvements in the Manufacture of Bichromate of Soda. E. P. Potter and W. H. Higgin, Little Lever, near Bolton. Eng. Pat. 5552, November 12, 1884.

THE salts thrown out from the chrome-liquor (referred to in Letters Patent No. 587, and No. 3329 of 1883) on concentration, are washed with hydrochloric acid in the cold. The sodium chloride remains behind, while the acid liquor contains the chromates in solution, and is used for bichromating further quantities of vat liquor.—A. R. D.

Improvements in Apparatus for Generating and Hydrating Sulphur Dioxide and like Gases and Vapours, partly applicable to Purifying other Gases. A. M. Clark, London. Communicated by W. Maynard, New York City. Eng. Pat. 6982, Nov. 17, 1884.

THE sulphur is burned in cups contained in a chamber to which air is admitted through a funnel-shaped inlet,

having the inner end the smaller. A goose-neck pipe leads from the top of the chamber to a closed box provided with a funnel delivering into another box below. Water is delivered by a pipe into this funnel, which has groved sides, so that the liquor running round, as well as downwards, forms a vortex, and draws away the vapours brought from the burning chamber by the goose-neck pipe. The gases, which are not absorbed by this washing, pass into the lower box. A pipe in the upper portion of this allows for the escape of the insoluble gases, the said pipe being provided with a scrubber of lime or other suitable material, to free the gases from all trace of acid vapours. To increase the efficiency of the water funnel as an aspirator, it may be revolved mechanically if necessary.—A. R. D.

Improvements in the Manufacture of Ammoniacal Salts, and in the Purification of Gas. A. McDougall, Penrith. Eng. Pat. 15,496, November 25, 1884.

SULPHUROUS acid gas, as obtained from a sulphur or pyrites burner, is forced through ammoniacal liquor, which also becomes concentrated by the passage of the hot gases. The ammonium sulphite which crystallises out, is oxidised in the air to ammonium sulphate. The solution of acid ammonium sulphite is used to wash coal gas, whereby ammonia is absorbed, and the sulphur compounds are decomposed, and sulphur separated, which latter is used in the burner as a source of sulphurous acid for the continuation of the process.—G. H. B.

Improvements in the Manufacture of Bichromate of Potash and other Chromates. Sidney Pitt, Sutton, Surrey. Communicated by Henry Bower, Philadelphia. Eng. Pat. 4102, November 27, 1884.

IN the ordinary process for the manufacture of chromates, whereby chrome ore is calcined in an oxidising furnace, with calcium hydrate or carbonate and the hydrates or salts of potash and soda, and the resulting mass lixiviated, a large percentage of the chromic acid being in a state of complex combination with iron, alumina and lime, obstinately resists solution. The present invention is for accomplishing this solution, by adding an alkaline carbonate to the mass in lixiviation, and then passing carbonic acid through the same. By this means all the chromic acid may be obtained in solution. A slight excess of carbonate—about five per cent.—must be used over and above the quantity equivalent to the as yet insoluble chromic acid, and the carbonic acid used must of course be free from all traces of sulphurous acid.—A. R. D.

Improvements in the Manufacture of Alkalis and Alkaline Salts. Sidney Gilchrist Thomas, Westminster. Eng. Pat. 4268, November 28, 1884.

IN the manufacture of alkaline phosphates and silicates from alkaline chlorides or carbonates, by treatment with molten phosphoric or silicious iron, in a basic or neutral-lined reverberatory furnace or converter, the reaction is accelerated and excessive volatilisation prevented by the present invention, which consists in mixing the chloride or carbonate with magnesia, lime, oxide of iron, or oxide of manganese, and compressing or fusing the mixture into bricks.—A. R. D.

Improvements in and relating to the Manufacture of Salt from Brine and Apparatus therefor. G. C. Denison and J. E. Higgin, Eureka Salt Works, Anderton. Eng. Pat. 4452, December 4, 1884.

A SYSTEM of pipes is so placed under the evaporating pan that the brine passing through the same on its way to the said pan, receives the heat of the furnaces, and thereby, to a certain extent, protects the pan bottom from burning. The pipes are arranged in rows across the flues, and have their ends connected by U-shaped junctions, the outside ends of which are closed by blank flanges or removable plugs, to make the whole length of each pipe accessible for cleaning. One end of the pipe system communicates with the pressure main or an elevated cistern supplying cold brine, and the other end delivers into the pan. This outlet is of diminished area to keep the brine in the pipes under pressure. The supply is preferably so regulated that the brine is delivered into the pan at a temperature just above boiling point.—A. R. D.

Improvements in the Treatment of Chloride of Sodium for the Production of Bleaching Powders and other Materials therefrom. W. S. Richardson, Gateshead, and W. J. Grey, Gateshead. Eng. Pat. 4417, December 5, 1884.

SOLUTION of sodium chloride is decomposed by an electric current. The chlorine evolved is used for making bleaching powder, the caustic soda is used as such or converted into carbonate, and the hydrogen is available for fuel. For the production or chlorine and metallic sodium, the fused chloride must be substituted for the solution of the salt.—A. R. D.

Improvements in the Manufacture of Chromates and Bichromates. W. J. A. Donald, Hillhead, Glasgow. Eng. Pat. 4811, December 15, 1884.

THE ordinary process for the manufacture of chromate of potash is followed in its first stages, with the exception that for the potash salts the sulphate, carbonate, or hydrate of soda is substituted. On lixiviating the batches from the chrome furnaces, a mixed solution of chromate of soda, sulphate of soda, etc., is obtained. To eliminate the sulphate, barium or calcium chloride is added, which causes an insoluble sulphate to precipitate, and leaves chloride of sodium in solution with the chromate. These may be separated by taking advantage of their different solubilities. To obtain sodium bichromate, sufficient sulphuric acid is added to the chromate to combine with half its soda. It is unnecessary to eliminate the sulphate present before this treatment, because it can be removed afterwards together with that formed on the addition of sulphuric acid to the chromate, as described above.
—A. R. D.

Improvements in the Manufacture of Chromates and Bichromates. W. J. A. Donald, Hillhead, Glasgow. Eng. Pat. 5948, December 15, 1884.

THE almost pure chromate of soda prepared as per application 4811, bearing even date with the present, is treated with its equivalent quantity of caustic lime, whereby chromate of lime is precipitated, and caustic soda remains in solution. These are separated by a hydro-extractor or filter press. The chromate of lime may be converted into bichromate by treating it with the equivalent of sulphuric acid to combine with half the lime, and evaporating until the sulphate of lime precipitates out, when it is removed by suitable means. The remaining solution, evaporated to dryness, gives very soluble and pure bichromate of lime.—A. R. D.

Process for Gilding Pottery. Ding. Polyt. Journ. 255 [3], p. 126.

THE "Ilmenauer Porzellanfabrik" in Ilmenau (Germ. Pat. No. 29566, February 15, 1884) gives the following process for this purpose. After a preliminary heating (to a red heat) a paste of gum and porcelain metal is applied by hand or otherwise, so as to form a pattern—*i.e.*, only the portions which are to be gilded are covered with the paste. The articles are dusted with powdered glazed porcelain and then dried until the small fragments dusted on are held by the gum paste. The articles are then burnt up and after cooling the raised parts (the so-called "*Decor*") are painted with gold, silver or other metallic colours and then the goods are fired as usual in the muffle. When finished the raised parts appear either biscuit or shining.—H. A. R.

Action of Dilute Acids on Bottle-glass. Dingl. Polyt. Journ. 255 [3], 127.

In a manufactory of artificial effervescing wines it had been noticed that all wines bottled from a new delivery of bottles turned turbid. E. Egger (Archiv für Hygiene, 1884 p. 68) tested the behaviour of various bottles towards dilute tartaric, hydrochloric and sulphuric acids and found that in some bottles the acid was reduced in quantity to a considerable extent in a short time. The analysis of two bad bottles (I. and II.), two pretty fair ones (III. and IV.) and two good ones (V. and VI.), yielded the following results :—

No.	SiO_2	$Fe_2O_3+Al_2O_3$	Mn	CaO	MgO	Na_2O	K_2O
I.	53·15	13·11	Traces	14·69	0·84	14·83	3·21
II.	52·90	12·85	Traces	15·88	0·95	14·27	3·16
III.	56·34	11·34	Traces	16·05	1·15	11·44	3·16
IV.	55·02	12·41	Traces	16·21	1·04	12·11	3·59
V.	62·95	6·80	Traces	16·72	1·80	9·26	1·40
VI.	57·16	11·79	Traces	11·79	0·90	15·41	2·72

A good glass-making mixture should contain enough SiO_2 that the fifth or sixth silicate of the alkali metal and the simple or double silicates of other oxides may be formed. For alumina we must assume the third silicate which softens at a white heat. Besides these there must be present a sufficient quantity of amorphous silicates to prevent devitrification. None of the above samples of glass contains enough silica for forming compounds which can be termed completely proof against acid fluids.—H. A. R.

Contributions to Our Knowledge of Cements. Dingl. Polyt. Journ. 255 [2], 76-79.

When cements are treated with water, H. Lechatelier (*Revue Industrielle* 1884, p. 452) finds that not only does calcium hydrate dissolve out but many other compounds. It is best then to use the least possible amount of water. He further notices that cements which have hardened quickly contain only a little free lime, when slowly a large quantity. By the gradual treatment of cements with water he thinks various compounds of lime with ferric hydrate, alumina and silica are formed in the solution. His analysis shows that these oxides are present in a litre of water in the proportion of the following theoretical compounds :—

	Grammes.
CaO_2H_2	1·3
$Fe_2O_3.4CaO.12H_2O$	0·6
$Al_2O_3.4CaO.12H_2O$	0·2
$SiO_2.CaO.3H_2O$	0·05

And he considers that these compounds, therefore exist in the cement.

Ed. Laudrin (*Compt. Rend.* 1884, 98, 1053) has formed mixtures of lime and silica in proportions equivalent to the various silicates. A mixture of $3CaO+SiO_2$ when heated to whiteness hardens by the action of either water or carbonic acid—he calls it "Pouzzo-Portland." A mixture of $2CaO+SiO_2$ only once yielded a porous mass having hardening properties when treated in the same way. Similar unsatisfactory results were obtained with $CaO+SiO_2$, which only after prolonged heating yielded a mass which set with difficulty and did not harden under water.

De Perrodil (*Génie Civil*, 1884, 6, 30) found that a sample of Longuetty and Co's. Portland cement had the composition :—

CO_2	23·8
SiO_2	1·3
Al_2O_3	8·9
Fe_2O_3	2·0
CaO	63·6
MgO	0·4
	100·0

When exposed to air or water it increases in hardness and absorbs water. The power of resistance of the mortar was greater under water than in air.—S. R.

A Method for Estimating Alumina in Cements. H. Prunier. Journ. de Pharm. et de Chem. 5, 87.

The cement is warmed with dilute nitric acid and the liquid treated with ammonia solution till neutral, using tropæolin as indicator. A known volume of semi-normal ammonia solution is then added, the solution diluted to a fixed volume and filtered. Part of the filtrate is titrated back with semi-normal nitric acid thus giving the amount of ammonia used to precipitate the iron and aluminium. The amount of ferric oxide present in the cement is determined by potassium permanganate, the difference then gives the amount of alumina.—S. R.

Artificial Marbles, Granites, etc. J. B., W. S. and E. S. Shaw, Stafford. Eng. Pat. 386, January 2, 1884.

Clay, cement or plaster is rolled, run or beaten out on a board or slab, into a "bat" of the desired size and thickness, which is then dried until it cracks in different directions. The cracks or fissures are now filled up with coloured clay, metallic and other colours, and water, etc., the bat being finally fired in the usual way. —E. G. C.

Improvements in the Manufacture of Marble. A. Guattari, Paddington. Communicated by Michele Soderini, Florence. Eng. Pat. 2640, February 2, 1884.

This invention relates to the manufacture of marble from sulphate of lime or gypsum, of which the several natural varieties may be used for the purpose—viz., selenite or sparry gypsum, lithoidal, massive or compact gypsum, anhydrite, pulverulent selenitic sulphate of lime, and fibrous, saccharoid, or calciferous gypsum. The first operation is the dehydration of the gypsum, which is effected in suitably constructed stoves, the temperatures of which vary with the different species of gypsum, from 50° to 244° C. The dehydrated rock is then hardened by being placed in a bath, consisting, as the case may be, of silicate of lime, sulpho-silicate of potash, acid fluo-silicate of potash, double silicate of potash and manganese, etc. Among the other substances employed are chloride of lime, sulphate of potash, phosphates of lime, soda, and potash, borax, etc. The material undergoes a second dehydration after being taken out of the bath. A second bath is frequently requisite, followed by a final process of dehydration. Various colours are imparted to the marble by the use of the following : Cadmium sulphate, yttrium chromate, and lithium chromate, which furnish yellows ; dragon's blood, scarlet madder-root, sesquioxide of iron, and didymium sulphate, which give reds ; salts of copper, which produce blues and greens ; and other compounds. —E. G. C.

Improvements in the Manufacture of Marble. Augusto Guattari, Paddington. A communication from Michele Soderini, Florence. Eng. Pat. 2787, February 5, 1884.

Sculptured objects in alabaster are hardened and converted into artificial marble by being heated to 37·5° to 50° C., and then immersed in a solution of 8 parts borax, and $\frac{1}{50}$ part potassium biphosphate, in 100 parts of water, at 22·5° C. After immersion in this solution, the objects are again heated in a suitable stove, this time to a temperature not exceeding 150° C. ; lastly, they are allowed to cool, and then again immersed in a solution of borax, to which is added nitric acid, varying in quantity from 50 to 30 per cent. of the water of the solution. The process may be modified by substituting oxalic for nitric acid, and by finally rubbing the objects with a mixture of Canada balsam and naphtha.

—E. G. C.

Imitation Marble. Augusto Guattari, Paddington. Communicated by Michele Soderini, Florence. Eng. Pat. 2847, February 6, 1884.

Sculptured objects in gypsum are dehydrated and coloured in one operation, by being immersed in a hot preparation of bitumen of suitable strength. A hard imitation marble, of a fine black colour throughout, is thus obtained.—E. G. C.

Improvements in Brick Kilns. H. J. Alison, London. A Communication from S. W. Underhill and G. E. Fisher, Rochester, N.Y., U.S.A. Eng. Pat. 13,260, October 7, 1884.

This invention consists in the construction of a "permanent base" of a brick kiln—*i.e.*, "a system of furnaces, flues, and reservoirs permanently constructed to support the pile of unburned bricks," the objects being "to obtain a greater percentage of perfectly burned bricks than results from the ordinary methods of burning; to secure economies and durabilities in construction; and to save labour and fuel." The brick kiln base is constructed of fire-clay, or other suitable material, moulded *in situ* by means of removable moulds or forms, and is furnished with a series of passages or hot air reservoirs, which extend through from one side to the other. From these reservoirs lead upwards a number of flues, the end flues being larger than those located nearer to the centre of the kiln-base.—E. G. C.

Improvements in the Manufacture of Artificial Stone. J. Hatfield, Kew. Eng. Pat. 14,621, Nov. 5, 1884.

To a mixture of one part hydraulic cement, one part crushed granite, and three parts blast-furnace slag, with a suitable quantity of water, the inventor adds one part of the substance known as slag-wool; the result is said to be a strong, tough, and durable stone.—E. G. C.

X.—METALLURGY, MINING, Etc.

On the Employment of Different Kinds of Fuel in Blast-Furnaces. Dingl. Polyt. Journ. 254 [4], p. 167–177.

H. Fehland (*Stahl und Eisen*, 1884, pp. 331 and 497) publishes some investigations on the time which a charge requires for passing through a blast-furnace. A certain Rhenish works, making white pig-iron, charges their furnace in 24 hours 40 times; each charge consisting of

3·75 tons ore	(1cb.m. = 1900kg.)	= 1·97cb.m.
1·25 „ lime	(2 „ = 1500kg.)	= 0·83 „
1·90 „ coke	(1 „ = 450kg.)	= 4·20 „
		7·00cb.m.

The cubical contents of the furnace is C = 232cb.m.; the latter therefore holds 33 charges, but as the charge sinters together, $\frac{1}{3}$ of the whole, or four more charges can be added. The time of passage for that furnace would therefore be 22 hours. A Westphalian works makes 34 charges, each of

3·20 tons ore	1·68cb.m.
1·10 „ lime	0·73 „
1·65 „ coke	3·67 „
	6·08cb.m.

The cubical contents is here C = 164cb.m.; it therefore holds $30\frac{1}{2}$ charges, and the time of passage is 21 hours. An Austrian works has 22 to 24 charges, each of

6·72 tons ore	3·62cb.m.
1·78 „ lime	1·13 „
3·80 „ coke	10·13 „
	14·88cb.m.

C is equal to 253cb.m.; it can hold 19 charges, and the time of passage is 19 to 21 hours. A far shorter time of passage can be attained at the cost of a larger consumption of coke. A Styrian works, working their furnace with charcoal, allow the charge to remain in the furnace for 14·7 hours. It further appears that for making

Iron rich in phosphorus	the time of passage for a charge is	18 hours.
Thomas-iron		17 „
Spiegel		$17\frac{1}{4}$ „
Iron for casting purposes		36 „

J. L. Bell read a paper at the meeting of the Iron and Steel Institute on the use of coal in blast-furnaces (*Iron*, 1884, vol. 23, p. 373). This paper would lose much of its importance by being abstracted.

F. Kupelwisser (*Oestr. Zeitschr. f. Berg. und Hüttenwesen*, 1884, p. 9) discusses the use of brown-coal in blast-furnaces. It can be employed either in the raw state, or coked, or by gasifying it and conveying the gases into the furnace. However, it can never be used by itself to replace coke, and after an extensive series of experiments it has been found that one part of brown-coal must be mixed along with three or four times its weight of coke. A host of investigators tried to convert brown-coal and lignite into coke, so that it could be employed exclusively in blast-furnaces, but all their efforts failed on account of the coke breaking up in small pieces, when exposed to heat. Others tried to obviate this evil by applying a substance which was to cement the pieces, and, indeed, W. Reuss and A. Hofmann seem to have lately solved the problem in this manner. Their process, which is kept secret, is worked at Sillweg, and of a charge of 2100kg. brown-coal, 56% is obtained in large lumps, and only from 30 to 40kg. in smalls.

W. Schmidhammer publishes a calculation on Bull's process for the use of water-gas in blast-furnaces. Supposing that 1kg. coal yields 1·53cb.m. water-gas, consisting of equal parts of carbonic oxide and hydrogen, the author calculates that 100kg. iron require 87·12kg. gas, for which production 57·15kg. coal are required. If carbonic oxide and hydrogen take an equal share in the reduction, and the relation of carbonic acid to carbonic oxide in the furnace waste-gases be equal to 0·63, the following calculation for 100kg. iron would throw a light on the economy of the process:

40·4kg. gas are required for the reduction of the roasted ore. The gas, consisting of 37·7kg. carbonic oxide and 2·7kg. hydrogen, burns to 59·2kg. carbonic acid and 24·0kg. water. For the reduction of 100kg. iron from their combination with 42·85kg. oxygen $42{\cdot}85 \times 3983 = 170671$ calories are consumed.

40·4kg. gas yield $40{\cdot}4 \times 5680$	= 229,472cal.
Less 10% loss	= 22,917 „
Leaves for disposal	= 206,525cal.

The process of reduction therefore shows an excess of $206{,}525 - 170{,}671 = 35{,}854$cal. To heat up and fuse the iron and the slags formed, are required:

For 100kg. iron	30,000cal.
„ 30kg. slags	13,500 „
Total	43,500cal.
And to keep the mass in a fluid state, and for losses	46,500 „
Grand total	90,000cal.

which can be produced by the combustion of $\frac{90000}{5680} = 15{\cdot}8$kg. gas, with a blast 800° C. hot. The 15·8kg. gas consist of 14·7kg. carbonic oxide and 1·04kg. hydrogen. The products of combustion are $\frac{14{\cdot}7 \times 44}{28} = 23{\cdot}1$kg. carbonic acid and $9 \times 1{\cdot}04$kg. water. The oxygen taken from the blast therefore amounts to $23{\cdot}1 + 9.39 - 15{\cdot}8 = 16{\cdot}69$kg., which are mixed with $\frac{16{\cdot}99 \times 77}{23} = 55{\cdot}8$kg. nitrogen. The quantity of air required is therefore $16{\cdot}69 + 55{\cdot}8 = 72{\cdot}49$kg. The carbonic acid in the waste-gases amounts to

Produced at the tuyeres	23·1kg.
„ by the reduction of ore	59·2kg.
Total	82·3kg.

The waste-gases are supposed to contain an equal quantity of carbonic oxide; the furnace therefore requires an excess of $\frac{82 \cdot 3 \times 100}{93 \cdot 3} = 88 \cdot 1$kg. gas. The total quantity of gas required now amounts to $15 \cdot 8 + 40 \cdot 4 + 88 \cdot 1 = 154 \cdot 3$kg., for which production $\frac{1 \cdot 64 \times 154 \cdot 3}{2 \cdot 5} = 101$kg. coal are wanted. The heat of the waste-gases and other small sources of loss or production of heat were left out of consideration in order to simplify the matter. It will, of course, be necessary to compare these figures with results obtained by the actual working of the process. From a practical point of view it appears probable that the work in the furnace will be rendered more difficult on account of the column of ore not being kept loose, owing to the absence of coke. The same circumstance will also offer difficulties to the passage of the gas, especially as there must be in some place of the furnace a zone where the slag is not yet in a fused state, but already sufficiently soft to resist the passage of the gas.—S. H.

The Utilisation of the Waste Gases of the Blast Furnace. Dingl. Polyt. Journ. 254 [6], 254, 1884.

Analyses of blast furnace gases, published by Bunsen in 1839, showing that these contained considerable amounts of carbonic oxide, methane and hydrogen, confirmed the opinions advanced by Aubertot, Curandaw and others, that these gases possessed considerable value as fuel, and gave an impetus to research, as to the best methods for their utilisation. A historical summary of the most important work upon the subject is here given, special attention being paid to improvements in and inventions of plant and processes described or patented in 1884.

The applicability of blast furnace gases to heating purposes, is lessened by the presence of flue-dust, water vapour and carbonic acid. For the elimination of flue-dust, Schrader and Macco (Ger. Pat. 28,003, January 13, 1884) allow the waste gases to pass from the cone into a wide chamber A (Fig. 1), where, from the velocity of the current being decreased, the larger portions of ash are separated from the finer, and fall into the furnace. The fine dust is collected in the compartments of the tube arrangement CD, through which the gases take the circuitous course indicated by the arrows. In Fig. 2 a box arrangement is shown, which may be substituted for the tubular system of Fig. 1. The filtration of the gases through slag-wool, is recommended by K. Möller; if sufficient surface of this be supplied to cool the gases below 100°, a portion of the aqueous vapour, and likewise tar and ammonia, if coal had been used, are collected. The co-application of water assists the condensation of ammonia. Cooling and washing chambers, devised by Alexander, as employed at the Gartsherrie Iron Works, and by means of which one ton of ammonium sulphate is recovered daily from the gases of two blast furnaces, are described by Lürmann (*Stahl und Eisen*, 1884, p. 35), and are illustrated by Figs. 3 and 4. The gases pass from the furnace by the main pipe G, through pipes g, the number of which is proportioned to the temperature and amount of the gases, into the coolers K, consisting of series of upright tubes, connected with each other alternately, above and below, so that the gases take the course

Fig. 1.

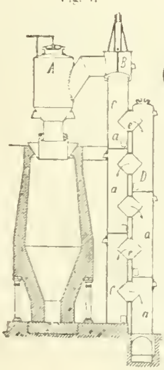


Fig. 2.

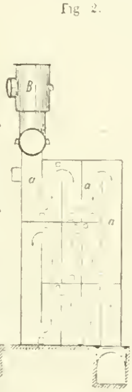


Fig. 3.

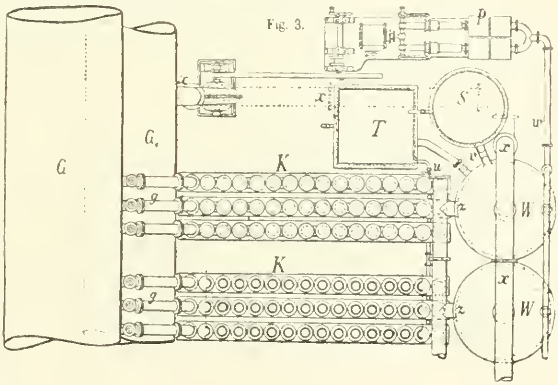
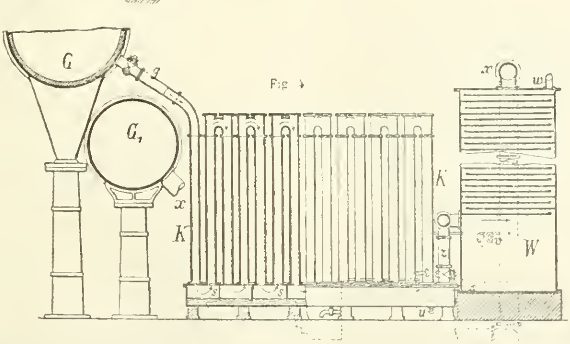


Fig. 4.



indicated by the arrows. Cooling is effected simply by reason of the large surface exposed by the pipes to the air. The pipe which connects the lower ends of these tubes also serves to collect condensed liquids, tar and ammonia water; these are not permitted to rise to such a height as to obstruct the passage of the gas, but are drawn off by the overflow pipe u, to the tank T. The gases pass through z into the washing towers W, provided with perforated shelves of wood or metal; a stream of water trickles from w down these shelves; the tar and ammonia, which have escaped condensation in K, are so collected, and pass from W into T and S. The watery liquid, which collects in S, is pumped by P to the top of the towers, and used repeatedly, until sufficiently enriched with ammonia. The cooled and washed gases proceed by x to the second main G, to be utilised as required. If it be desired simply to eliminate flue dust, the towers are unnecessary; but it is advisable in such a case to moisten

Fig 5

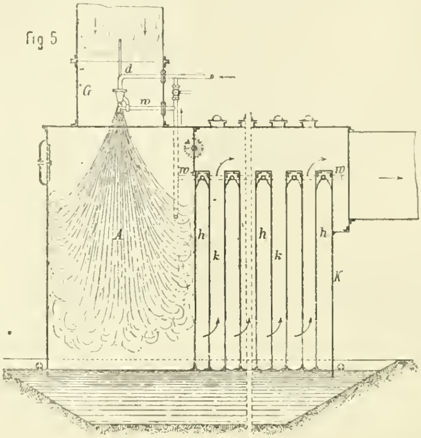


Fig 6.

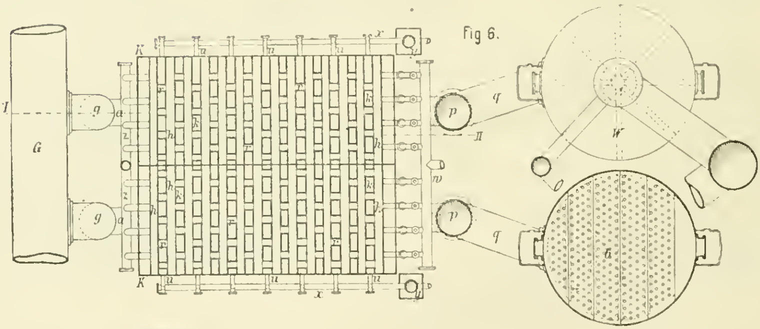
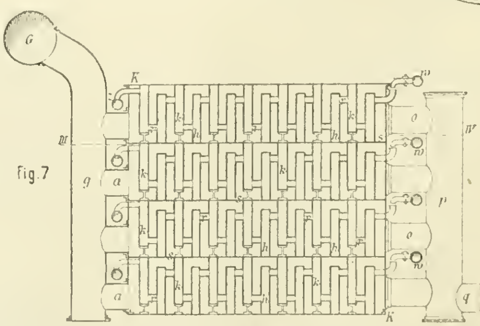


Fig. 7



the gases before they enter the coolers. Belani advocates the arrangement illustrated in Fig. 5, for moistening the flue dust; steam is passed into the main pipe G, the moistening being completed by the application of a water spray in A, at the bottom of which chamber the wet dust collects. The cooling space K is divided into compartments by partitions h, down the sides of which streams of water flow, and effect the cooling of the gases, which pass up and down the spaces k. In Figs. 6, 7, 8, are given respectively the plan, elevation, and front view of the large cooling and washing chamber, devised by J. Alexander. Each chamber K is divided vertically into two compartments; these again, each horizontally, into four. The gases pass from the main G through the vertical pipe g, thence by the horizontal connections a into the compartments. Extending the whole width of the compartments, and riveted to the walls thereof, are rectangular boxes k and h, connected with each other by tubes r, through which a stream of water is caused to flow from m, that is to say, in a direction contrary to that of the stream of gas. The liquids, which are condensed in the compartments, are run off through tubes u into pipes x (Fig. 8) outside the chambers, thence away by y. The two vertical compartments K, oppose to the gases a surface of 2200 square meters, cooled by water; and one of 500 square meters cooled by air only. The gases leave the horizontal compartments by the short tubes o, thence pass into the upright pipes p, leave these at the bottom by q, and are thence led into the towers W, provided with perforated shelves of wood or metal, which are so fitted that the gases pass at each shelf from one side of the tower to the other, depositing any residual tar.

Fig 8

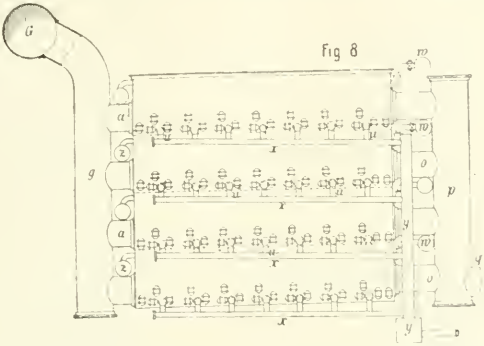
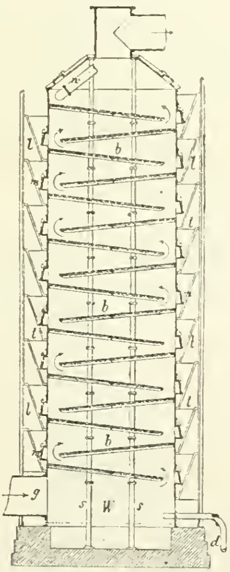


Fig. 9.



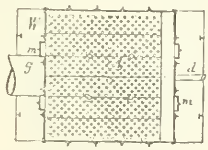
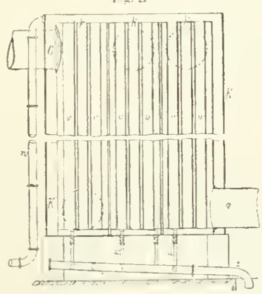


Fig 10.

Fig. 11



The rectangular wash tower W, shown in Figs. 9 and 10, with sloping shelves, is an improvement upon those of circular section, as the gases are distributed more evenly. The man-holes m are the more easily reached by the steps t outside the tower. The shelves are cleansed from tar by passing steam in the tower by d. This tower

has a cubic contents of about 720cb.m., an outer surface of about 480 square meters; the shelf surface is in all about 560 square meters.

A cylindrical cooler, shown in Figs. 11 and 12, has likewise been devised by Alexander. Within the large cylinder K, seven smaller cylinders k are placed. These

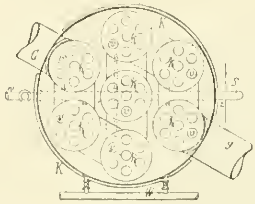
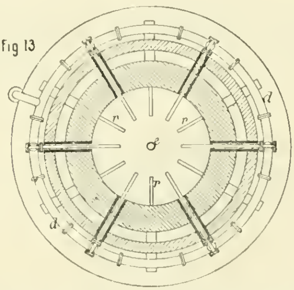


Fig. 12.

are connected with each other alternately, at top and bottom, so that the gases from G take a circuitous course to g. Within each small cylinder, seven pipes are fitted; these are open to the large cylinder K, which is filled with water. The cold water enters at W, the warmed

Fig 13



flows away by w, liquids condensed from the gases are withdrawn by u and z. The surface cooled by water is about 1700 square meters; that cooled by air 288 square meters; and if necessary 2000 square meters of surface, cooled by water, can be obtained.

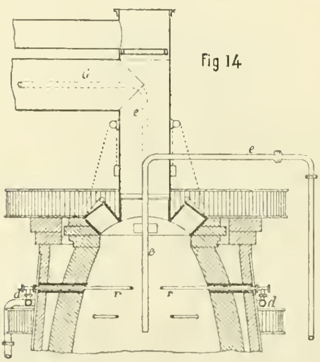
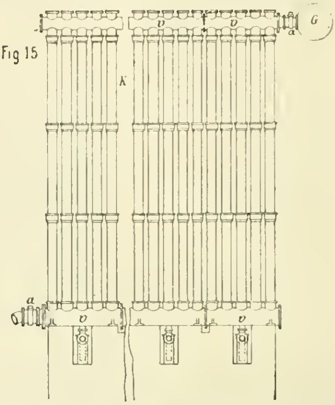


Fig 14

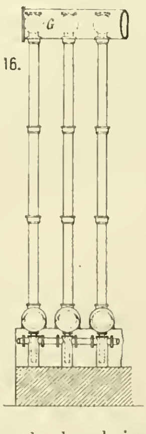
To increase the yield of ammonia, from blast furnaces using coal, it is proposed to introduce steam at numerous points within the cone, 2 or 3m. below the mouth. An arrangement for this purpose is shown in Figs. 13 and 14. Or the steam may be introduced by a single jet in the centre; and if desired can be superheated by allowing the steam supply pipe to pass for some distance in the interior of the pipe conveying away the waste gases.

Fig 15



The arrangement of pipes shown in Figs. 15 and 16 has been devised by Körting Bros., and is equally applicable to the cooling as to the washing of the waste gas. The tubes are arranged in three ranks; and connections between the individual pipes of each rank are so made that the gases pass up through one set of five pipes and down through the next. A system of 450 tubes of 300mm. diameter, and 3·5m. in length, gives a total surface, cooled by the air, of 1700 square meters. An injector may be advantageously applied at different points of such a system.

Fig 16.



The large washing chamber, devised by Young and Beilby, built of masonry, shown in Fig. 17, affords a means of decreasing the velocity of the stream of gas, and of thus allowing a complete separation of tarry matters. The gases are introduced by the conduit g, and enter the chamber by the openings e, covered by leaden bells. A fine rain of water, acid, or acidified water, is maintained during the passage of the gas. The washed gases pass away by G, the washings by u.

A somewhat more advantageous arrangement is that shown in Fig. 18. A series of such chambers may be built on different levels, so that the liquid employed for washing being introduced at the opposite end of the system to that at which the gas enters, passes simply by gravity through the whole series, until spent. The disadvantages of having to pump the liquid to the top of the chamber and there spray it, is obviated by the above plan. The size of the chambers is advantageously such that for 100cb.m. of gas passed through in twenty-four hours, at least 0·5cb.m. of space is provided. Large chambers, in which the cooled gases can come to rest and deposit their particles of tar, appear to be most suitable for the complete separation of the tar.

Fig 17.

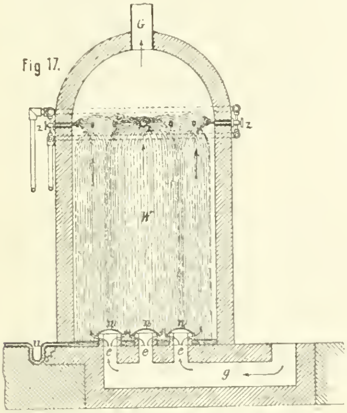
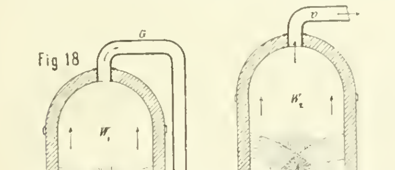


Fig 18



For the regeneration of blast furnace gas,—*i.e.*, the reduction of carbon dioxide to the monoxide, Ehrenwerth recommends the employment of the shaft furnace, shown in Figs. 19 and 20. This is filled, through F, with coke, wood charcoal, or the like. Through the pipe *w*, and tuyères *v*, air can be supplied. Through the pipe *g* and mouths *e*, the waste gases enter the furnace. The mouths permitting the gases to enter, may be 10 or 20cm. above or below the air tuyères, or even side by side with these, in which case they should have a wide section. If intermittent work is alone desired, the coke or charcoal is first brought to a sufficiently high temperature by the application of the air blast, which is then almost shut off, and the waste gases allowed to stream through until the temperature has fallen to such an extent as to render regeneration imperfect. The gas is now shut off, and the air blast again applied, and so on. For uninterrupted work, two regenerators, at least, are required. It is pointed out that the gases obtained during the heating up of the charcoal or coke are similar to ordinary generator gas; and, therefore, need not be lost. Blast furnace gases regenerated according to this plan, may be advantageously employed in the Siemen-Martin process. The following analytical results permit of a comparison between ordinary generator gas and blast furnace waste gas, ordinary and regenerated:—

Fig 19.

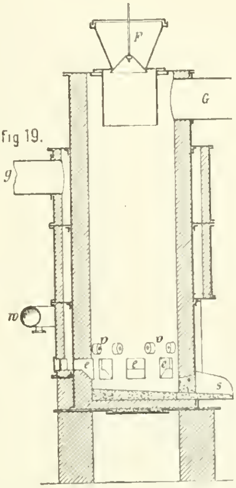
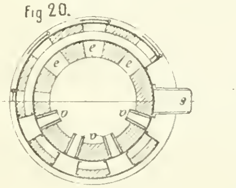


Fig 20.



	Generator Gas from		Blast Furnace Gas.		
	Coke.	Coal.	Ordinary.	Completely Regenerated. (theory)	Practically Regenerated.
CO	33·8	25·0	24·23	42·42	31·87
CO_2	1·3	6·5	20·60	0·00	8·37
Hydrocarbons	—	1·5	0·38	0·21	0·28
H	0·1	0·5	0·21	0·15	0·18
N	64·8	66·5	54·58	57·22	56·30
Total	100·0	100·0	100·00	100·00	100·00
1 kilo of gas yields calories	841	920	688	1087	923

F. Lürmann proposes to employ this regenerated gas in the blast furnace. The gases of the reduction zone would, in this case, contain less nitrogen than when, as usual, the carbon is gasified by direct combustion with atmospheric air.—W. D. B.

Method for the Manufacture of Malleable Nickel and Cobalt. Dingl. Polyt. Journ. 1884, 254, 315.

Nickel or cobalt (according to a statement of the Berndorfer Metallwaaren-Fabrik, Ger. Pat. 28,989, January 15, 1884), when in a melted state, take up carbon and oxygen simultaneously, the greater part of the latter being given off again on cooling, leaving the

metal in a porous condition. Although by continued melting in graphite crucibles, under a cover of charcoal, the oxygen may be entirely expelled, the metal takes up the more carbon the longer it is kept in a melted condition, and thus becomes more and more brittle. In order to overcome these difficulties, the oxides of the metals are reduced at a moderate heat, and the porous cubes obtained immersed in a 4 per cent. solution of an alkaline manganate or permanganate. After drying they are melted, whereby the carbon is oxidised, the metal at the same time taking up a small quantity of oxygen. To get rid of this, a small quantity of black flux (obtained by igniting cream of tartar in a covered crucible) and some charcoal is added as soon as the metal flows freely. By the combined action of the charcoal and the potassium vapours generated from the black flux the oxygen is quickly removed. Instead of black flux aluminium, calcium, calcium-zinc, in quantities of one-tenth per cent. of the metal or mixtures of two or more of these materials in combination with charcoal may be successfully employed for the purpose of removing the last traces of oxygen. Enough charcoal is added to form a layer on the surface of the molten metal, through which the deoxidising metals are introduced.—F. M.

The Preparation and Application of Weiller's Silicon-Bronze. Dingl. Polyt. Journ. 254 [12], 492.

In the *Bulletin de la Société Industrielle de Marseille*, 1882, p. 150, appears a paper by X. Müller, engineer to L. Weiller, of Angoulême, from which the following information has been taken :—

The oxide present in a mass of metal or alloy occasions an absence of homogeneousness, which is fatal to the qualities regarded as essential. Experiments in Weiller's factory have established this, especially as regards the production of wire required of good conductivity and strength for electrical purposes. Carbon was found to be unfit for preparing a metal free from oxide, because an excess of carbon proved still more deleterious, and was unavoidable. Phosphorus gave better results, but traces of phosphorus in the metal lessened its conductivity and made it brittle; phosphorus being applicable only where resistance to impact or friction is desirable.

The advantage of using silicon has been already shown by Sainte-Claire Deville, but its cost was too great for general application. After three years' research, L. Weiller has obtained satisfactory results. Potassium silico-fluoride in presence of sodium supplies the silicon which effects the reduction of the oxide in the alloy, which at the same time takes up only traces of the metalloid, the excess floating with the slag. It is only necessary then to pour the alloy into moulds; the cast bars are afterwards turned and drawn in the ordinary way. This process of deoxydation is applicable to various alloys for different purposes, but especially for electrical connections. The silicon-bronze is well adapted for articles subject to pressure, impact or friction, such as valves, bearings, etc.

The electrical quality of silicon-bronze wire as now delivered by L. Weiller for telegraphic purposes corresponds to the following formula: From the resistance R_o at 0° the resistance R_t at t degrees is found according to the formula $R_t = R_o (1 + kt.)$, and for silicon-bronze wire for telegraphs $k = 0{\cdot}0039$, and for telephones $k = 0{\cdot}0015$.

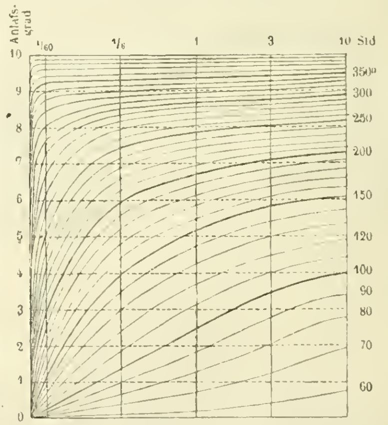
The reason for the difference in the two sorts of wire is that for telegraphs superior conductivity is the principal requisite, whilst the short circuits of telephone wires in towns allow some sacrifice of conductivity for the advantage of greater strength. Telephone wires of this material in Triest have satisfactorily withstood the most violent storm-winds. Complete security is assured with spans of 300 to 350 metres. On account of its strength this material does not require the support of iron wire for sub-aqueous cables of short length.

Tables of comparison with pure copper wire are quoted. Estimations of installations for 1000 kilometres show a saving of over 30 per cent. for silicon-bronze as against iron wire. Its use for telephones and telegraphs has been found successful in France and Austria by various companies and official departments. —G. H. B.

On the Influence of the Temperature of Tempering on the Quality and Constitution of Steel. A. Jarolimek. Dingl. Polyt. Journ. 255 [1], 1–10; [2], 56–60.

These two papers deal with the relations of the various physical properties of steel to one another, and to its chemical constitution. The author shows that the intermediate temperatures to which the steel is subjected, as well as the mechanical processes employed, affect considerably the final hardness and elasticity. An investigation on the specific volume of steel has long been wanted, and without doubt would throw considerable light on many of the difficult problems connected with this subject. The author has previously shown (Dingl. 1876, 221, 436, 518), that the hardness of steel depends on the rate by which it cools down from a definite critical temperature, which for most kinds is somewhere about 500° C. In his previous experiments he determined the hardness obtained by heating the steel to different temperatures, varying from that of boiling water to that of molten zinc. The temper of the steel depends on the time at which it is kept below another limiting temperature.

Strouhal and Barus (Würzburg, 1882), in a paper on the influence of the hardness of steel on its magnetic



and other physical properties, have drawn attention to the fact that the thermoelectric, conducting and magnetic properties of a tempered steel wire depend in the same way on the limit of temperature to which it has been exposed. The amount of hardness was determined by taking long pieces of the steel and forming them into spiral springs, which could be then stretched by different weights. In this way the author demonstrates that the limit of elasticity of these springs of steel, as shown by their greater bending and twisting, increases with the amount of heat to which they have been exposed. This limiting temperature is about 300° C, but if after having been stretched, the wire is again heated, the traction power is found to have increased. Experiments are described with the following five operations being varied: (1), heating the wire; (2), winding the wire into a spiral; (3), heating the spring; (4), stretching the spring; (5), heating the stretched spring.

From these experiments we learn that the elasticity is increased by long stretching of the wire, and that this elasticity is not lost by heating to 300° C. and then slowly cooling. He next discusses the relation of this experiment to the specific volume of the steel, and shows that the specific volume of the steel is of less

practical value than the physical constants above described. The tenacity and solidity of the steel, in the same way, is directly influenced by the hardness, and so by the temperature and time employed in tempering.

W. Lorenz has described (Dingler's, 1880, 235, 183) a method for determining the hardness of hollow bodies. Compression of the steel, when still red hot, by means of two metal plates connected with a hydraulic press capable of giving a pressure of 1000 to 3000kilos. per square centimetre, causes the solidity to be increased.

The curves in the diagram show the rate of change of temper with increase of time at different temperatures.

The author has found that in some experiments with tools hardened in this way the results obtained were very satisfactory, but considers that further inquiries are needed before the different behaviour of steels can be explained and useful results obtained.—S. R.

On some New Alloys and their Uses. Dingl. Polyt. Journ. 256 [2], 73.

TH. FLEITMANN, of Iserlohn (D.R.P., No. 25,924 A., January 6, 1884), has shown that pure nickel and its alloys with copper, cobalt and iron can have other metals added without their losing the property of being welded, and therefore can still be used for making plate. The metals which can be added in this way are zinc, tin, lead, cadmium, iron and manganese up to as much as 10 per cent.; any additions, however, are not of much practical value, as the alloy of 25 parts of nickel with 75 of iron has a white colour, and resists the action of the atmosphere far better than iron alone. —S. R.

A New and Improved Process and Apparatus for the Extraction of Metals from their Chlorides or Fluorides. Lorentz Albert Groth, 30, Finsbury Pavement, London. Communicated by Richard Grätzel, Hanover. Eng. Pat. 551, January 3, 1884.

THE extraction of certain metals, such as magnesium and aluminium, is to be effected on a large scale by the electrolysis of the fused chloride or fluoride in the presence of a reducing or neutral gas. The negative electrode may be the containing vessel itself or otherwise; the positive electrode (of carbon) is separated from this by a tube of non-conducting material with apertures (or open) at the lower end, but closed above, with the exception of a tube provided for the removal of chlorine or other gases evolved during the process. In close proximity to the positive electrode may be placed rods or plates, composed of the oxide of the metal under treatment mixed with carbon, which should be slightly in excess of the amount required to form carbonic oxide, and made up with tar or dextrine, dried and heated to redness. These serve to regenerate the haloid compound electrolysed. The whole is closely covered and provided with two tubes, one for the admission and one for the removal of the reducing gas. —W. G. M.

An Improved Smelting Furnace. Charles Bramhall, Oughtbridge, near Sheffield. Eng. Pat. 586, January 3, 1884.

THE invention relates to an improved smelting furnace, for reducing iron ore or pig iron, for converting them into steel, and also applicable to smelting furnaces for other purposes. The furnace described in the specification, and illustrated by a drawing, has the general shape of a cupola or blast furnace, fitted with five or a larger or smaller number of tuyeres, and intended to be worked with gaseous fuel. The air and the gas are blown into the furnace by separate blowing engines and separate pipes, and pass each through two sets of receptacles filled with bricks heated alternately on the regenerative principle. The air and gas tubes unite near the inner wall of the furnace. The hot gases escaping near the top of the furnace are led by flues through the regenerators, thence to a chimney. Valves or dampers are introduced for the regulation of the supply of both gas and air.—B.

A New or Improved Method of Treating Sulphides and Oxides of Metals and Obtaining Products therefrom. Sir Francis Charles Knowles, of Lovell Hill, Bart., Mayfield, Isle of Wight. Eng. Pat. 7056, Jan. 3, 1884.*

IN pursuance of this invention, sulphides or oxides of iron are subjected to a full red heat in a closed retort, through which a current of coal gas, peat gas, or petroleum vapour passes, whereby the iron oxide is reduced to a metallic, or, on prolongation of the process, converted into a carburet. Ores so reduced are treated in a Bessemer converter with a small admixture of molten spiegeleisen, and subjected to the blast of a neutral mixture of air and carbonic oxide gas, which process is continued until complete fusion. For the production of a mild steel, a blast with a slight excess of air is used. With appropriate re-agents, and a non-silicious lining, phosphorus, if present, may be eliminated. Ores of other metals may be similarly treated.—B.

Furnaces for Making Malleable Iron and Steel. J. Burch, Stockport, and R. Allen, Manchester. Eng. Pat. 1086, January 9, 1884.

THE present improvements are supplementary to those described in Eng. Pat. 3250, 1882. The principal features of the former invention comprise three sections—viz., a main firegrate, combined with a reverberatory rocking hearth of unusual length, and a balling cylinder which rotates. The new system of continuous puddling consists in feeding a fresh charge of molten metal into the fore end of the furnace every time the hearth rocks to and fro, and the charges are, by the rocking motion, caused to follow each other throughout the whole length of the refinery chamber into the balling cylinder, from the far end of which the several charges are delivered in the form of puddled balls. The balling cylinder has a downward inclination from the end contiguous to the refinery chamber. The several charges of metal gradually become pasty and coherent, as, by the rotation of the cylinder, they are caused to move along a spiral gutter made in the form of a hollow curve around the interior of the cylinder; by this means all the charges in the cylinder are made to advance one turn of the spiral every time the cylinder rotates, and by degrees they become solid masses, which are gradually rolled in the curved gutter into the form of puddle balls, and which, as they slowly approach the firegrate at the end of the cylinder, are exposed to the increasing "final heat," and the slag becomes highly fluid, so that it readily separates from the puddle balls, and falls through a sloping grid, down which the balls roll to the trolly. The chimney is erected at, or contiguous to, the lowest end of the refinery chamber.—J. T.

Recovering Tin from Tinned Metallic Surfaces. A. P. Price, London. Eng. Pat. 2119, January 25, 1884.

THE superficially tinned metals are made to form the anode in a solution of caustic alkali, a dynamo electric machine or other electric generator being employed. The tin being dissolved may be obtained from the solution by electric agency or otherwise, or the resulting stannate may be employed in the arts.—J. T.

The Extraction of Metals from Carbon, or Substances known as such—namely, Graphite, Coal, Coke, Cinders, and Ashes. Annie Eliza Scott, South Kensington, London. Eng. Pat. 2162, January 26, 1884.

THE carbonaceous substance is mixed with salt and placed in a crucible in alternate layers with fragments of metal; on heating, the latter fuse and are to alloy with the metals contained in the former. Or the alloying metal (*e.g.*, copper, zinc, etc.) may be first fused and the carbon then added. From the residual soluble silicate any of the alloying metal oxidised is to be recovered. —W. G. M.

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* This patent is either wrongly dated or wrongly numbered—7056, January 3, 1884. At that date the number of patents taken out had not reached much above 500.—B.

Improvements in Puddling Furnaces. George Morris and George Slater, both of West Bromwich. Eng. Pat. 3065, February 11, 1884.

THE improvement consists in the introduction of a cast-iron or brick water chamber between the flue-bridge and the flue of the puddling furnace, so arranged that the flame and products of combustion passing from the puddling chamber impinge upon the surface of the water, which is preferably at the same level as that of the brickwork in the ordinary furnace. The supply of water may be obtained from the tool bosh, used by the puddler for cooling his tools. The slag pressed over the flue bridge flows into the water and is granulated. The cooling action of the water prevents the rapid destruction of the flue stack by the hot gases and permits the use of an inferior brick.—W. G. M.

Improvements in obtaining Aluminium Bronze. Anthony Zdziarski, Brest-Litowsk, Russia. Eng. Pat. 3090, February 11, 1884.

CRYOLITE or other aluminous matter is fused with suitable fluxes in a crucible containing the metal with which the aluminium is to be alloyed (copper, brass, etc.). A current from a powerful dynamo machine is then passed through the liquid mass, using carbon as an anode and the alloying metal itself as the cathode. Silica must be absent or silicon will pass into the metal.—W. G. M.

Improvements in the Method of Protecting Submerged Structures of Iron and Steel from Corrosion and Fouling. F. Maxwell Lyte, London. Eng. Pat. 3536, February 18, 1884.

IN a previous communication (Eng. Pat. 5375, of 1883) the inventor showed that it is necessary to interpose between the anti-fouling paint and the metallic iron a coating serving to isolate the anti-fouling paint from the iron so as to avoid the rapid destruction of the former and the corrosion of the latter. Bitumen forms an excellent undercoating both in respect of cheapness and efficiency. The paint is produced by dissolving natural bitumen in turpentine, benzene, or benzoline to the requisite thickness, and adding, if desirable, zinc oxide or hydroxide, or glass, porcelain, burnt clay, silica, alumina, magnesia, powdered chalk, or calcareous rock, asphalte, barium sulphate, powdered coal, anthracite, coke or graphite, or the so-called silicate paint, and if considered necessary, drying oils so as to constitute a paint with which the iron is first coated and on which the anti-fouling paint is applied.—D. B.

Improved Basic Linings for Open Hearth Steel and Iron Furnaces. William F. Batho, 9, Victoria Chambers, Westminster. Eng. Pat. 3921, February 26, 1884.

THE basic lining is to be mixed with metallic iron (wire, scrap, etc.), in such a way that the metal will act as a bond, and will always form a portion of the wearing surface of the lining.—W. G. M.

A New or Improved Method of Extracting Metals from the Material found combined with Coal, commonly known as Ironstone. John Miles, High Holborn, Middlesex. Eng. Pat. 4333, March 4, 1884.

THE coal containing the ironstone is to be burnt and the residue strongly heated for 48 hours in a steel crucible with its own weight of scrap steel. It is then cooled in a closed vessel and the powder and pieces of metal are ready for any purpose to which the inventor may propose to apply them.—W. G. M.

An Improved Method of Tinning Plates. By Thomas Henry Johns and William Albert Johns, Clapton. Eng. Pat. 13,235, March 10, 1884.*

THE invention relates to a method of coating light sheets, generally called "taggers," or ordinary plates, without passing them through a tinning bath. As an illustration, there may be two baths side by side, the one containing coating metal for treating plates in the ordinary way, the other containing grease, and between the two a pocket also containing grease. Above the pocket the finishing rolls are placed. Plates having passed through the tin bath and into the centre grease pocket, are raised and passed through the finishing rolls, and when several such plates have been treated, they leave the rolls coated with a certain amount of metal. Other plates, such as "taggers," or ordinary kinds, having meantime been prepared in the grease bath; if one of these is now passed through the rolls it will receive a thin coat of metal. The rolls may be supplied or fed with coating metal in any other convenient way.—B.

* The above patent is either wrongly dated or wrongly numbered—13,235, March 10, 1884. At that date the number of patents taken out had not reached much above 4000.—B.

An Improved Method and Apparatus for the Amalgamation of Free Gold. Rowland John Atcherley, of 52, Chancery Lane. Eng. Pat. 4865, March 14, 1884.

THE invention relates to apparatus by means of which the free gold to be saved from gold-bearing slimes, or pulp, is caused to pass through a continuous fine shower of mercury, and is thus brought into such intimate contact therewith as to be thoroughly amalgamated, and thus to prevent the escape of float or flour gold. The apparatus consists of a vat or trough, the bottom of which is perforated with a great number of small holes. The trough is placed above and along the flumes or launders conveying the slimes or pulp, and should be of the same width as the launders. A receptacle is placed at the lower end of the launders for catching and collecting the mercury after passing through the slimes, from which receptacle it is raised again to the perforated trough by means of an elevator, a pump, or in any other convenient manner, thus making the action continuous. Provision is made for collecting the mercury clear of slimes, and for straining off any solid or semi-solid amalgam before returning it to the trough.—B.

Improvements in the Manufacture of Chromic Compounds. Sidney Gilchrist Thomas. Eng. Pat. 5130, March 19, 1884.

THE invention relates to the manufacture of chromic compounds from chrome iron ore. The ore is first treated in a blast furnace, in which, by preference, an excess of coke or charcoal and very hot blast are used, so as to produce a pig containing nearly all the chrome alloyed with iron and carbon. This chrome pig is then treated in the molten state in a gas furnace or Bessemer converter having basic or neutral linings, such as lime, magnesia, or chrome iron ore. Into the converter, or furnace, there is introduced a quantity of lime, or of alkaline chloride, or of alkaline carbonate or hydrate, or of magnesia, more than sufficient to combine with the chromic oxide formed by the oxidation of the chromium as well as with any silicon or phosphorus present in the crude iron—potassic or sodic carbonate or hydrate are preferred. A slag consisting largely of alkaline or calcic chromate is formed, and, after lixiviation with water, the solution is treated for the manufacture of any chrome salt required.—B.

Improvements in the Manufacture of Sodium. Sidney Gilchrist Thomas, 9, Palace Chambers, Westminster Bridge. Eng. Pat. 6367, April 15, 1884.

WROUGHT or cast-iron retorts or tubes, with a thick lining of any refractory material unacted upon by sodium—*e.g.*, highly fired lime, magnesia, or dolomite, or graphite are used. Into these the mixture of sodium carbonate and carbon may be fed continuously; through them is passed a current of reducing gas (preferably water-gas) previously heated to a high temperature in small regenerators. The retorts will not require external firing. The gases, charged with sodium vapour on leaving the retorts, are passed through a condensing arrangement, and are then burnt in the regenerators.
—W. G. M.

Improvements in Separating and Obtaining Silver from Metallic Compounds. Desmond G. Fitz-Gerald, Brixton, Surrey. Eng. Pat. 6371, April 15, 1884.

THE argentiferous metal is treated with nitric acid containing an oxidising agent, such as binoxide of lead, or of manganese, to recover the oxides of nitrogen otherwise lost. The silver in solution, as nitrate, is then precipitated as chloride by hydrochloric acid (preferably gaseous), thus leaving free nitric acid in solution, or by calcium, barium, or lead chloride—the nitric acid being afterwards regenerated by treatment with sulphuric acid, or the silver may be thrown down as oxide by calcium or barium hydroxide. The chloride, or oxide, is then deposited in an electrolytic cell, on a negative element of silver, using zinc or iron as the positive metal.—W. G. M.

An Improved Compound Metal or Alloy, chiefly designed for Deoxidising and Coating Metal Plates. Henry Harris Lake, Southampton Buildings, Middlesex. Eng. Pat. 6433, April 16, 1884.

THE proposed alloy consists of lead, tin, and zinc, together with a small proportion of sodium, in proportions varying with the use to which the coated metal is to be applied. The metals, after interfusion in a crucible, are ready for use; while fused the mixture is covered with a vegetable oil, or animal fat; it has a very low fusing point.—W. G. M.

Improvements in Obtaining Copper. Astley Paston Price, Lincoln's Inn Fields, Middlesex. Eng. Pat. 6722, April 23, 1884.

COPPER is precipitated from solution by finely divided iron, the liquid meanwhile being well agitated by steam, air, or otherwise.—W. G. M.

A New or Improved Process of Treating Iron. Alex. Melville Clark, 53, Chancery Lane, Middlesex. Communicated by Russell B. Abbott, of Albert Lea, Minnesota, U.S.A. Eng. Pat. 7940, May 19, 1884.

THE object of this invention is to produce from ordinary wrought iron a weldable iron of superior toughness and hardness. It is to be effected by heating the metal nearly to a welding heat, then rolling it in an intimate mixture of fourteen volumes of sand with one of manganese dioxide and one of common salt, by working, reheating, and repeating the treatment, and finally by again reheating to a weld heat and quenching in water. The mixture may, if preferred, be pressed into contact with the metal by any convenient method other than rolling.—W. G. M.

An Improved Method and Furnace for Obtaining Crude or Course Copper directly from Copper Ores and Mattes. Alex. Melville Clark, 53, Chancery Lane, Middlesex. Communication from Jules Garnier, Paris. Eng. Pat. 9498, June 27, 1884.

THE furnace is in the form of an inverted truncated cone, and is mounted on hollow trunnions to facilitate the discharge of its contents in case of emergency. The lower portion of the furnace is lined preferably with a material incapable of being attacked by the basic constituents of the ore—such, for example, as oxides of chromium, natural calcium sulphates, zinc silicate, titanium compounds, bauxite, calcium phosphates, etc.—whilst the upper part is lined in the usual way, the two linings being separated by a zone of refractory clay. If the ordinary lining be used throughout, the lower portion should be very thin and be air or water-cooled. The inert materials are applied in the form of bricks (or in the plastic state), made up with clay, lime, tar, etc. The blast, entering by the trunnions, passes through chambers surrounding the furnace, thus effecting the double object of heating the blast and cooling the furnace walls; thence it passes through tuyeres situated between the tap-hole, which is at the bottom of the furnace, and the slag hole. The ore, or matte, is charged in the usual way, and, when melted, fills the crucible up to the level of the tuyeres; the slag hole is then stopped and the air blown by high-pressure blast through the accumulating sulphide, resulting in the production of crude copper, which collects in the crucible and is tapped off at intervals; of sulphur dioxide, which passes off with the blast; and of oxides of metals, more basic than copper, which pass into the slag, and are removed also by tapping. The fusion of the matte may also be effected by a low-pressure blast, introduced above the slag hole, until the sulphide reach the level of the latter, when the high-pressure blast at the lower level is let on.—W. G. M.

Coating Metal, Glass, Porcelain, etc., with Ornamentation of Aluminium or Aluminium Bronze. C. D. Abel, London. Communicated by G. Gehring, Landshut, Bavaria. Eng. Pat. 13,425, October 10, 1884.

ALUMINIUM or aluminium bronze, either in the shape of foil or as powder, is applied to the surface by the aid of the following substances:—Sebacitate of alumina or resinate of alumina—that is to say, alumina soap—is mixed with oil of lavender or other volatile oil and the aluminium. The alumina soap is formed by precipitating a solution of either common soap or resin soap by means of alum. These alumina soaps are dissolved in volatile oils to form a thin lac, which is incorporated with the aluminium, and the mixture is applied to the surface to be coated by means of a brush. The surfaces so treated are then exposed to the open air or to heat, as the case may be.—J. T.

An Improved Process for Coating Iron or other Metals with Tin, Lead, or Terne. Adolph Gutensohn, Globe Wharf, Mile-End Road. Eng. Pat. 13,560, October 14, 1884.

THIS process consists in the substitution of a hot saturated solution of sal-ammoniac, together with a little hydrochloric acid and glycerine, containing a small quantity of resin, for the grease bath generally used preliminary to the tinning of the pickled plates. —W. G. M.

Improvements in Treating Copper Matte. A. W. L. Reddie, Bream's Buildings, Chancery Lane. Communication from John J. and Robert Crooke, of New York, U.S.A. Eng. Pat. 14,853, November 11, 1884.

THE object of the invention is to separate objectionable impurities, such as arsenic, antimony, iron, and lead, and to recover the silver and gold contained in the matte, and to produce a pure copper at a minimum cost. The first or desilverising process is conducted in a reverberatory furnace of 2 tons' capacity, having a tap-hole, and a working and an end door; in front of the tap are a pair of 10-ton iron lead kettles. 3 tons of lead are heated strongly, 2 tons of the crushed matte added, and the mass well rabbled. A partial oxidation of the sulphur, attended by a rise of temperature, now occurs, and the lead alloys with the silver, gold, antimony, and arsenic. After a further rabbling for 15 minutes, 60 per cent. of the added lead separates, and in half-an-hour it is tapped into one of the kettles. A further addition of two tons of lead is now rabbled in for half-an-hour, and tapped into the same kettle. It is essential to success that the mixture be maintained at a low temperature, below the fusing point of the matte, or the silver will not be removed. The pasty plumbiferous charge is then transferred to a second reverberatory furnace, where the removal of all the lead, excepting about 500lb., is effected by reduction with 400lb. of anthracite slack, at a much higher temperature, and by subsequent tapping. The kettle lead is desilverised by zinc, and is then ready for a new charge. The desilverised regulus is run into sand moulds, broken up, and heated to dull redness, with blast from two 1-inch tuyeres. When at a dull red heat the blast is let on, and the mass is kept below the melting point of copper, and is well rabbled for an hour. Mass copper begins to form, and when the fragments no longer have a bright surface the blast is shut off. Eight per cent. of sand is now added for each 12 per cent. of iron originally present,

and the heat raised for copper fusion. The slag formed should be pure black, free from red tinge, and containing less than 1 per cent. of copper; it is skimmed off as fast as it appears, until oxide of copper forms on the surface of the metal bath, when the copper is at once tapped into sand moulds, and afterwards remelted and brought to tough pitch. The slags carrying much lead are reduced by carbon. If the slag should have a red shade, 1 per cent. of raw desilverised matte will at once clean it of copper. The total loss of lead should not exceed 1 per cent.—W. G. M.

Improvement in the Treatment of Phosphatic Slags. Carl Scheibler, Berlin. Eng. Pat. 15,140, November 18, 1884.

When phosphatic slags—and especially those from the Thomas-Gilchrist process—are cooled very slowly, they are found to separate into two layers, the upper one containing the bulk of the phosphoric acid, the lower that of the iron and manganese. It is therefore proposed to run the slags into vessels lined with a non-conducting material, and allow them to cool slowly in bulk until the solidification of the outer surface occurs; the inner fluid portion is then run off, and is found to contain the greater part of the phosphorus as calcium phosphate, which may be treated for manure; the solid crust, containing most of the iron and manganese, is returned to the blast furnace. The longer the time allowed for solidification the more complete will be the separation. —W. G. M.

Improvements in the Manufacture of Phosphatic Salts. Sidney Gilchrist Thomas, London. Eng. Pat. 4947, December 12, 1884.

Phosphoric pig iron is run into a basic or neutral lined converter or furnace, into which magnesia to the extent of four or five times the weight of phosphorus calculated to exist in the iron has been already introduced. The usual basic or Thomas Gilchrist or Siemens operation is then carried on till practically all the phosphorus is eliminated from the iron, when the metal and slag are run off separately. The latter contains all the phosphorus as phosphate of magnesia, and is either fused or boiled with an alkali, or else treated with dilute hydrochloric acid for its recovery. The magnesia is also recovered and used over and over again.—A. R. D.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

The Decomposition of Wool Grease. Dingl. Polyt. Journ. 255 [2], 88.

Ceryl cerotate is obtained by Buisine from wool grease by saponifying at 100° C. with alcoholic potash, then distilling off the alcohol forming the barium salt, and then treating with boiling alcohol. The ceryl alcohol, which is difficultly soluble, is obtained from the solution along with homologous crystallisable fatty alcohols. The part of the fat which is the most difficult to saponify contains the largest proportion of cerotic acid.—S. R.

On the Boiling Point and Specific Gravity of Glycerine. Dingl. Polyt. Journ. 255, 208, 1885.

G. Th. Gerlach, in his investigations on glycerine, started with so-called "double-distilled glycerine," which had a specific gravity of 1·23. This glycerine was distilled from a tubulated glass retort until the boiling point remained constant, and the distillation was continued for some time longer. The glycerine remaining in the retort was perfectly pure and clear as water. The corrected boiling point was 290° C. The glycerine boiled very quietly and uniformly, and, on account of its fixed boiling point, can be safely recommended for determining the point 290 on thermometers for high temperatures. The specific gravity of solutions of glycerine was as follows .—

Percentage of Pure Glycerine.	At 15° C.	At 20° C.
100	1·2653	1·262
90	1·2100	1·236
80	1·2130	1·209
70	1·1850	1·182
60	1·1570	1·155
50	1·1290	1·128
40	1·1020	1·101
30	1·0750	1·071
20	1·0190	1·048
10	1·0245	1·0235
0	1·0000	1·0000

—W. M.

Recovering Oil and Grease from Fibrous Material. E. S. Wilson and A. B. O'Connor, Camberwell. Eng. Pat. 2621, February 2, 1884.

This process has for its object the purification and recovery of oiled and greasy fibres, and extracting valuable products therefrom, by means of chlorinated alkaline leys, hypochlorites of soda or potash. The loose oil is first extracted by hydro-extractors or other suitable means. The waste is then boiled in water or very weak leys, any oil that rises to the surface being skimmed off. The liquor is then drawn off into tanks, that the oil or grease may come to the surface. (If the leys have been used, the addition of acid may be necessary to facilitate the separation.) The waste is then boiled in water containing a small percentage of soap; a solution of chlorinated leys is then added at a strength of 15-20° Tw., and the whole agitated at a temperature o 140-180° F.—J. T.

Hard Soap Making. C. D. Abel, London. Communicated by Die Fabrik Chemischer Produkte, Berlin. Eng. Pat. 6472, April 17, 1884.

This process has for its object the production of a hard soap that shall be practically almost completely freed from the lyes, and that shall contain much less salt than ordinary curd soap, while at the same time a much harder and more neutral product is obtained, containing also less water (from 20 to 25 per cent.) than that obtained in the ordinary way. The soap, separated by salt by the known methods, and before its separation from the lye by complete cooling has taken place, is introduced into a centrifugal machine driven at a high speed, and is subjected, while in a heated condition, to centrifugal action for a comparatively short time (from four to, at most, twenty minutes). By this means the separation of cocoanut oil soap can be perfectly effected. —J. T.

Apparatus for Cooling Oil in Order to Congeal Paraffin. N. M. Henderson, Broxburn. Eng. Pat. 9557, June 30, 1884.

The apparatus comprises a trough formed with a jacket space through which refrigerated brine or other suitable cooling fluid circulates; and in order to obtain efficient cooling surfaces there are placed within the trough a number of transverse vertical disc casings with thin spaces for the circulation of the cooling fluid. A horizontal rotating shaft passes through the centres of the disc casings, and carries scrapers which detach the paraffin as it congeals on the cooled surfaces; whilst a lower shaft, with agitating arms, breaks up and mixes the congealed paraffin so as to facilitate its discharge along with the oil.—J. T.

Apparatus for Extracting Oleaginous Matters from Bones, etc. L. Steinmüller and C. Steinmüller, Gummersbach, Germany. Eng. Pat. 11,104, August 9, 1884.

In this invention the petroleum naptha or other vapours required for the extraction of fatty matters are forced from the top of the apparatus over the substances to be treated, and pass to the bottom, carrying with them the fat extracted.—J. T.

Improvements in Materials for Lubricating Metal Moulds. H. J. Haddan, London. A Communication from C. F. Brush, electrical engineer, of Cleveland, Ohio, U.S.A. Eng. Pat. 3581, Nov. 17, 1884.

IN making lead castings, saponifiable and oxidisable oils have hitherto been used to lubricate the moulds, and the result has been the formation of a hard deposit, partly of lead soap, partly of oxidised oil on the mould-surfaces, which interfered seriously with the perfection of the casting. The inventor claims the use of vaseline, diluted with a hydrocarbon such as kerosene, describing it as a material for lubricating or coating moulds, a non-oxygenous or nonsaponifiable oily substance, and a non-oxygenous or non-saponifiable diluent, both incapable of complete evaporation at the melting point of lead.—W. L. C.

Improvements in Apparatus for Extracting Fat and Glue from Bones. G. W. von Nawrocki, Berlin. A Communication from J. Wellstein, of Bamberg, Bavaria. Eng. Pat. 5841, November 25, 1884.

THIS is a description, with figure, of a well-devised and complete arrangement for the treatment of bones in the same extracting vessel: (1) with a solvent such as benzene for the extraction of all fat, the solvent being of course recovered by distillation and used several times in succession; (2) with a weak solution of oxalic or hydrochloric acids, for a greater or less time and under more or less pressure according to the age of the bones; (3) with hot water for the extraction of the glue. A special feature claimed is a perforated coil or rose in the top of the extractor employed in conjunction with an injector below, the effect of which is to draw off the solvent from below and flush the bones with it from above. Details are also given of certain special modes of connecting the extractor with the condenser, the solvent-store and the still in which the solvent is vaporised.—W. L. C.

The Manufacture of Rosin Soap. John Imray, London. A Communication from H. J. E. Heunebuth, of France. Eng. Pat. 5154, December 9, 1884.

PRIOR to saponification, powdered rosin is to be treated with sulphurous or sulphuric acids, or with a weak solution of sulphate of alumina. The soap may be used either alone or mixed with a fat soap or with silicate of soda.—W. L. C.

XII.—PAINTS, VARNISHES, Etc.

On Iron Paint. Ding. Polyt. Journ. 255 [1], 48.

THE Dutch Railway Company have tried a series of experiments on the various pigments used for coating iron and their best method of application. They find that red lead is better than any of the oxides of iron used, and that the paint is more satisfactory when the metal has been previously cleaned with hydrochloric acid than when it has only been cleaned by friction. The Cincinnati Southern Railway Company also find that red lead is the best for their iron bridges.—S. R.

The Preparation of Brilliant-lac. Dingl. Polyt. Journ. 255 [1], 48.

TO obtain lac of different colours, coal-tar dyes are dissolved in spirit, the concentrated solution is allowed to stand for a week or two in a dark and cool place and then filtered. The clear solution is then added to the shellac till the required colour is obtained.—S. R.

Apparatus for Manufacturing White Lead. J. Kay, Bury. Eng. Pat. 727, January 5, 1884.

THE wicket lead is placed on an endless belt and carried to breaker, or crushing mill, which consists preferably of three pairs of horizontal rollers, placed vertically over each other. The crushed lead is passed through an inclined revolving screen, the interior of which is studded with pegs to prevent the blue lead from passing through too rapidly. The white lead drops through the perforations of the screen into the hopper of a grinding machine. This consists by preference of three pairs of horizontal rollers placed vertically over each other, each roller sliding horizontally in the contrary direction to its fellow, so as to increase the grinding power and to keep the rollers true. —J. T.

Improvements in Paints. F. Wirth, Frankfort-on-the-Main. Communicated by O. Fischer, Karlsruhe, Germany. Eng. Pat. 2539, February 1, 1884.

THE following mixture is recommended as a body colour to be laid on previous to the oil colour, and which by admixture with further materials is applicable as a substitute for linseed oil: 100 parts of blood, 10 parts of scalded linseed, 190 parts of water, and 10 parts of potassium chromate. Applied as a substitute for linseed oil in mixing colours, this preparation is treated in the proportion of 275 parts with a compound consisting of 75 parts of petroleum, 20 parts of linseed oil, 1 part of pyrolusite, 1 part of hydrochloric acid, and 3 parts of resin. To combine this compound with the first mixture, 2 parts of soap dissolved in 23 parts of water are added.—D. B.

White Lead Manufacture. H. G. Blyth, London. Eng. Pat. 10,375, July 19, 1884.

OXIDE of lead, obtained by the cupellation of impure Spanish lead, or by heating impure carbonates, both mineral and artificial, are employed. When there is much calcareous matter present this crude oxide cannot be advantageously employed. The oxide is placed on a false bottom of porous material in a vessel and treated with solution of lead acetate, an old and well-known process. The solution from beneath the false bottom is run into a second tank and permeated with carbonic acid gas. By a process of upward filtration the liquid overflows from the lower tank, and is pumped back to the upper one. When the bottom part of the lower tank is full of precipitated carbonate it is lowered away from the upper portion, turned over on trunnions and emptied. —J. T.

Apparatus for the Production of White Lead. Dingl. Polyt. Journ. 254 [12], 489.

IN order to granulate lead for white lead making, J. C. Martin, of Richmond, England (D.R.P., No. 28,322, of August 31, 1883), lets it fall on a rotating cylinder, from which any adhering lead is removed by scrapers. Graphite or steatite may also be used to lessen the adhesion. The pellets of lead fall from the cylinder A (Fig. 1) upon a movable platform or belt, formed of two endless chains *a*, carrying lathes *m*, keeping the chains at a suitable distance from each other, the whole working over two cylinders *v*. This lead, on falling into the water, is removed on the endless belt *m* and deposited outside the trough. The manufactured white lead is dried in a series of closed cylinders A (Fig. 2), each of which contains a worm *s* formed of copper bands to impel the white lead forwards. The supply funnel *t* leads to a cylindrical chamber, in which a shaft *o* revolves slowly, carrying arms covered with leather which conducts the supply of white lead gradually to the drying chambers. The cylindrical chamber *k* represents an enlarged continuation of the cylinders A, and contains a paddle-wheel *r* fixed to the shaft *w*. The paddles *a* are so placed that by revolving in the direction of the arrow the white lead is removed from the chamber *k* into the end of the second trough. When the white lead arrives at the end of the first cylinder, it falls into the chamber *k* through the opening *x* in the sides of the wheel *r* and through the spaces between the paddles *a*, so that by the continued motion of the paddle-wheel the white lead is carried up on the inner circumference of the chamber *k* until it falls through the opening *u* into the next trough A. Here the white lead receives motion in an opposite direction by the worm *s*, and finally leaves the apparatus at the opening N of the last trough. The hot

air used for drying enters through a conduit above, on one side of the cylinder, and escapes on the other side through a pipe *z*. The washing apparatus, for separating white lead from unattacked metal, of H. Kirberg, of Hilden, near Düsseldorf (D.R.P., No. 28,528, of January 9, 1884), claims to be more efficient and less liable to get out of order than the one invented by Horn. beaters *f* screwed on to the beams *e* (Fig. 4), effect a thorough agitation and thereby a rapid separation of the mass of oxide into its constituents. The perforated tray-shaped discharging scoop *g*, which takes up the particles of lead freed from oxide from the bottom of the vat and throws them into the funnel *h*, is movable on its upper portion round a peg attached to an arm *i*,

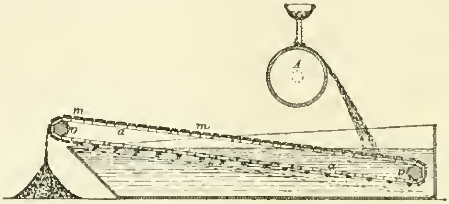
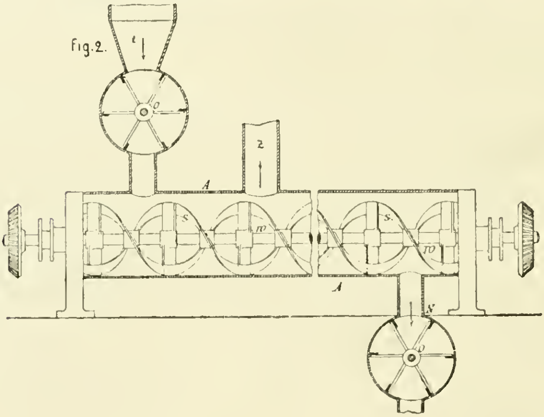


Fig 1.

Fig.2.



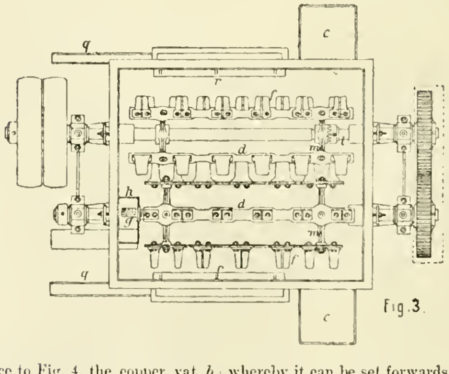


Fig.3.

As will be seen by reference to Fig. 4, the copper vat *b* completely closed with a wooden cover and fastened to the cast-iron supports *a*, is fed with the mass of oxide to be operated on, and also with the necessary washing liquid through the funnels C (Fig. 3) fixed to the vat. The two reels *d*, turning in opposite directions by means of toothed wheels driven by pulleys and provided with whereby it can be set forwards or backwards according to the required amount of discharge by means of a screw arranged underneath. In order to effect a slow or quick washing of hard, or in the other case of soft, oxide the coupling *l* is opened, by which the cross-piece *m* running loose on the axle can be turned a little, whilst the second cross-piece remains fixed, and in this way the beams *e* and

the surfaces of the beaters are brought to an inclination with the axis of the apparatus, whereby the rapidity of the motion of the mass towards the place of exit is regulated. After the required displacement of the beams *c* (Fig. 5), the coupling *l* is again closed, and by screwing tight is ensured against becoming loose again. The water, charged with lead oxide, flows through the sieve

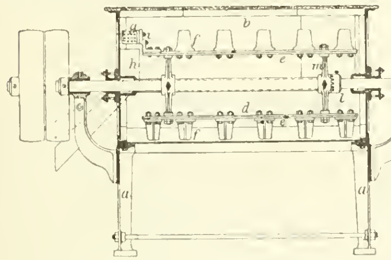


Fig. 4.

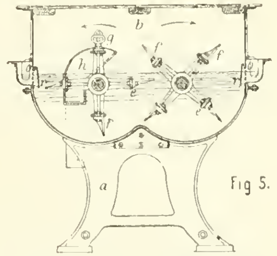


Fig 5.

o situated at the surface of the liquid into the long box closed with a lid and through the trough *q* into the settling vat. The protecting screen *r* which, hanging from the sieve *o* and leaving an opening underneath, and is easy to remove for cleaning, prevents the entrance of small metallic particles of lead into the sieve, whilst the direction of motion of the mass of oxide, and therewith also of any accompanying particles of metal, tends downwards on the side walls of the apparatus.—G. H. B.

XIII.—TANNING, LEATHER, GLUES, SIZES, AND RESINS.

Improvement in Tanning. Frank Werth. Eng. Pat. 1857, January 21, 1884.

THIS covers the use of dried peat moss made into bricks or mixed with vegetable tanning materials rich in tannin, and also with mineral tanning substances, such as alum, salt, and chromate of potash.—H. R. P.

Improvements in Apparatus for Tanning Hides and Skins. Ambrose Myall, London. Eng. Pat. 3174, February 12, 1884.

TWO or more laticed tanning drums of the ordinary description are placed in a circular vat provided with a vertical shaft in the centre, by means of which the drums are made to rotate round the vat, at the same time turning on their axes with a rolling motion. The vat is supplied with liquor by a centrifugal pump, from a series of tanks in which it is filtered and settled. The patentee also claims the ordinary form of tanning drum which has been in use in English and American tanneries for more than 20 years.—H. R. P.

Improvements in Machines for the Manufacture of Leather. Ambrose Myall, London. Eng. Pat. 3374, February 15, 1884.

THE subject of this patent is a machine identical in construction with the Priestman striking machine generally used in finishing offal; the use of serrated blades for fleshing and unhairing; and the drum is to be covered with pumice, emery paper, or cloth, for various other operations, such as ruffing, whitening, and polishing.
—H. R. P.

Improvements in Waterproofing Leather. Wm. J. Gale. Eng. Pat. 4826, March 13, 1884.

THE leather, after washing with warm water, or with weak solution of soda or other alkali, is exposed to the fumes of ammoniacal gas, and then slowly dried in a closed chamber.—H. R. P.

Improvements in the Treatment of Leather. James Paterson. Eng. Pat. 6756, April 24, 1884.

LEATHER intended for belts, hose pipes, etc., either curried or rough dried, is soaked in a solution of wood-resin and gum thus (frankincense), melted together, dissolved by heat in linseed oil, and afterwards mixed with petroleum, benzolene, or bisulphide of carbon, and a small quantity of India-rubber solution. When thoroughly saturated, the leather is washed in a bath of petroleum-benzolene, and dried on racks or otherwise. The tendency of the leather to stretch is said to be materially lessened.
—H. R. P.

Improvements in the Process for Tanning Tawed Leather. Caeser Kaestner, Magdeburg. Eng. Pat. 11,442, August 19, 1884.

ALUMED leather is tanned with a solution of tannin in alcohol instead of water, by which the leather is completely tanned in eight days. Tannin, catechu, and picric acid are mentioned as suitable materials.—H.R.P.

XIV.—AGRICULTURE, MANURES, Etc.

On the Preparation of Phosphates. Dingl. Polyt. Journ. 255 [1], 35.

DREYFUS obtains phosphoric acid from mineral phosphates by treating them with sulphuric acid in leaden vessels. The gypsum formed is removed by a filter-press, and the solution of phosphoric acid concentrated by causing a flame to play upon the surface of the liquid, which is placed in a leaden pan over an open fire. The pan rests on a bed of sand, and is surrounded by a wall of stone. In an oven 5 or 6 metres long, and 1·5 wide, 8000 kilos. of phosphoric acid can be concentrated. A less advantageous method is to concentrate the solution in wooden vessels lined with lead, by means of superheated steam under 3 or 4 atmospheres. The precipitate consists mainly of gypsum, undecomposed oxides of iron and alumina, and from 2 to 3 per cent. of combined phosphoric acid. It is used as a manure under the name of *phosphate-gypsum.* The phosphoric acid can be mixed with powdered phosphates to form super-phosphates containing 43 to 44 per cent of soluble phosphoric acid, or can be used for the preparation of precipitated phosphate of lime. Adair and Thomlinson (D.R.P., Class 16, No. 28,739, August 12, 1883) obtain the phosphoric acid out of slags and minerals, by first reducing to a fine powder, then roasting if carbonic acid or calcium phosphate is present, and finally decomposing with strong caustic soda in the proportion of three equivalents of soda to one of phosphoric acid. The mixture is strongly heated in iron vessels, and the solution of phosphate of soda filtered or decanted from the precipitate. The solution when concentrated can be purified from silica, alumina, manganese or iron, by passing through it a current of air and carbonic acid. The precipitate is separated, and calcium phosphate thrown down from the solution by the addition of milk of lime. If a basic slag or iron ores containing phosphorus is being used, a mixture of potassium and sodium carbonate solutions is employed instead of the caustic alkali. Caustic ammonia or ammonium car-

bonate solution can be employed in the same way in closed vessels. The ammonium phosphate can be crystallised from the solution, or calcium phosphate can be prepared as previously by precipitation with milk of lime.—S. R.

On the Preservation of Frozen Potatoes. Dingl. Polyt. Journ. 255 [1], 45.

FITTBOGEN has examined frost-damaged potatoes which had been stored in silos, and finds that they lose their value as a food stuff very rapidly. He analysed the ensilage after 50, 76, and 140 days, and found that the loss of fat increased from 57·1 per cent. after 50 days, to 87·0 per cent. after 140 days. A corresponding loss in the amount of starches and albuminoid substances was also noticed. This method of preservation is not to be recommended.—S. R.

Value of Cockchafers as a Manure. Dingl. Polyt. Journ. 255 [1], 46.

F. A. WOLF kills the chafers by enclosing them in a vessel with carbon-bisulphide. After ten or twenty minutes they are dead, and can be then heated to 60° in a kiln for five hours ; they lose in this way about 65 per cent. of their weight, but when dried can be kept for any length of time. The product contains 12 per cent. of nitrogen, 1·2 per cent. of phosphoric acid, and 1·2 per cent. of potassium. The organic matter consists of 38 per cent. of albuminoids, and 10 per cent. of fats.—S. R.

On the Employment of Artificial Manure in Potato Culture. S. Guradze. Biedermann's Cent.-Blatt. 1883, 6, 377.

THE author made experiments with Chili saltpetre, superphosphate and patent "potash-magnesia." The tabulated results are as follow :—

On the Manurial Value of the Deposit from Urban Refuse-Water. M. Fleischerem. Biedermann's Cent. Blatt. 1883, 6, 426.

IN Bremen, the waste-water from houses and manufactories, together with large quantities of urine, is conducted by channels into a river with a sluggish current. The deposit formed in the river bed has been examined by the author, who finds it to possess an acid reaction, and to contain hydrated forrous-oxide. On ignition in a platinum dish, sulphurous acid is given off. One thousand parts of this material contain—

	Dry.	With 45 per cent. water.
Potash	6·3	3·5
Lime	17·2	9·5
Phosphoric acid	8·0	4·4
Total nitrogca	11·6	6·4

By exposure to the atmosphere and consequent loss of water, the fixed constituents could be brought to from 50-60 per cent., and 25 centners would then be worth 18 marks, and contain 4·4kg. potash, 12kg. lime, 5·5kg. phosphoric acid, and 7·0kg. nitrogen. The material must be exposed to the air for some time before being applied to the soil, because of its richness in sulphur compounds. The sulphuric acid, resulting from the oxidation of the metallic sulphides, would be advantageously neutralised by an admixture of calcareous matter. Another example of deposit from a pond, with which the refuse matter of a portion of the town had been conducted for a long period, furnished the following figures :—

	As collected.	Dried at 100 degrees.
Water	889·7	—
Combustible matter	27·2	251·0
Nitrogen therein	1·46	13·2
Insoluble in HCl	52·25	498·8
Potash	0·98	8·9
Soda	0·31	3·1
Lime	1·91	17·3
Magnesia	1·35	12·2
Ferric and aluminic oxides	18·25	165·5
Phosphoric acid	0·52	1·7
Sulphuric acid	3·65	33·1

This sample, as collected, had an acid reaction, and

Field.	MANURE PER ACRE.				Cost of Manure.	Yield per Acre, ctr.	Starch %.	Starch per Acre, kg.
	Stable Manure, ctr.	Superphosphate (20% P.), kg.	Chili Saltpetre (16% N.), kg.	Patent Potash-Magnesia, kg.				
I.	90	—	—	—	—	63·0	11·0	411
	90	30	25	—	12·30	76·2	15·1	587
II.	90	—	—	—	—	72·2	15·1	515
	90	—	—	25	3·20	81·7	15·8	669
	90	25	—	25	7·20	84·3	16·0	671
	90	25	25	32	14·90	88·1	16·4	727
III.	—	37·5	37·5	—	17·25	93·0	13·9	616
	—	—	—	—	—	86·0	13·5	581
IV.	90	—	—	—	—	92.0	11·7	676
	90	25	—	—	1·00	101·6	11·9	779
	90	—	25	—	7·50	119·0	15·1	898
	90	25	25	—	11·50	128·2	15·6	999
V.	80	—	—	—	—	82·0	16·6	681
	80	35	—	—	5·60	85·2	15·4	656
	80	35	35	—	16·10	86·0	16·0	688
	80	35	35	50	22·50	96·3	15·5	716

The soil of Nos. I. and II. fields was a loamy sand ; that of No. III., loam ; No. IV., loamy sand to sandy loam, and pure loam of the muschelkalk formation ; and No. V., warm loamy sand.—E. G. C.

evolved much sulphuretted hydrogen on the addition of HCl. With a proportion of 45 per cent. of water, 25 centners of this material would represent a value of about 19·4 marks.—E. G. C.

On the Employment of Basic Phosphate of Lime as an Addition to Fodder. Dr. Cohn. Biedermann's Cent.-Blatt. 1883, 6, 428.

THE author, after referring to the writings of Lehmann, Gohren, and Schieweck, who state that calves, bullocks, sheep, and swine assimilate calcic basic phosphate, recommends this compound as being a wholesome addition to cattle food. To lambs and young pigs 8-12 grm. per head and day should be given, to calves and foals 12-20grm., and to cows and bullocks 20-25grm.
—E. G. C.

Remarkable Influence of Manuring on the Composition of Potatoes. Professor M. Marcker, Graeger and Vibrans-Calvörde. Biedermann's Cent.-Blatt. 1883, 6, 365.

THE experiments were carried out on a good soil of sandy loam, which in the previous year had yielded barley and clover. The manure used contained 20lb. of soluble phosphoric acid per acre, together with varying quantities of Chili saltpetre. Certain plots were left unmanured. The yield of potatoes was greater on the manured plots than on the unmanured, but it was found that manuring with considerable quantities of Chili saltpetre had had the effect of considerably diminishing the percentages of dry substance and starch (the latter by as much as 6 per cent.). The albumen and other nitrogenous constituents were, however, augmented.—E. G. C.

The Manuring of Beet-Roots. Dr. Holdefleiss. Biedermann's Cent.-Blatt. 1883, 6, 380.

As the result of his experiments, the author concludes that a moderate quantity only of stable manure, together with Chili saltpetre, should be used; also that manure too rich in nitrogen has a pernicious influence; and finally, that in the absence of stable manure, the addition of Chili saltpetre and superphosphate simultaneously is to be recommended.—E. G. C.

A New Material for the Manufacture of Peat Manure and on the value of this kind of Manure. M. Fleischer, C. Spierling, and others. Biedermann's Cent.-Blatt. 1883, 6, 368.

HITHERTO moss-peat from the North German moors has been chiefly used; the principal characteristics of this peat are its affinity for moisture, its elasticity and softness, even when dried, its property of absorbing ammonia and carbonate of ammonia from refuse animal matters, and its high proportion of nitrogen as compared with other similar materials. It is now proposed to employ a fibrous peat from Schleswig and Würtemburg, consisting chiefly of *phragmites communis*. One hundred parts of the air-dried Würtemburg peat (containing 20 per cent. of water) were found to absorb and hold 933 parts of water, while 100 parts of the Schleswig peat took up and held 630 parts of water; 1000 parts of Würtemburg peat absorbed 16·8 parts of nitrogen in the form of ammonia, and 1000 parts of Schleswig peat absorbed 13·0 parts; 1000 parts of the ordinary North German moss-peat absorbed 17 parts of ammoniacal nitrogen. A comparison of the three kinds of peat, as regards their constituents, yielded the following results in 1000 parts of completely dried material:—

	Wurtemburg fibrous peat.	Schleswig fibrous peat.	North-West German moss peat.
Nitrogen	about 22 parts.	29 parts	9 parts.
Phosphoric acid..	0·6 „	0·6 „	0·4 „
Lime	17·2 „	31·0 „	2·0 „

It is evident from these figures that both the Würtemburg and Schleswig peats are considerably richer in nutritive constituents than the moss-peat. Experiments made by several observers as to the efficacy of manures, consisting of admixtures of peat with other substances, such as Chili saltpetre, bone-meal, stable manure, etc., have yielded decidedly satisfactory results.—E. G. C.

The Behaviour of Legumin with Solutions of Common Salt. H. Ritthausen. Biedermann's Cent.-Blatt. 1883, 6, 398.

TH. WEYL discovered that leguminous seeds contain proteïd bodies soluble in a solution of salt. The author made some legumin preparations by extraction with aqueous potash and precipitation with acetic acid, and found them to be for the most part insoluble in salt water. The salt water solutions, however, gave when highly diluted considerable precipitates, which after washing with alcohol and drying over sulphuric acid, formed white, shining, brittle masses. Legumin from pease furnished 20·6 – 26·2 per cent. of proteïd matter soluble in salt water; that from broad beans, 18·8 and 28·8 per cent; legumin from vetches, 23 per cent.; and that from chick-pease (*Lathyrus*), 24·8 per cent. The composition of the soluble matter (calculated on the material free from mineral matter) was as follows:—

	From the legumin of pease.	From the legumin of broad beans.
C	51·62	50·93
H	6·96	6·95
N	18·26	17·91
S	0·33	0·27
O	22·83	23·94

The compounds of tannic acid with albuminoid bodies are completely insoluble in salt water, and as the occurrence of tannic acid in the shells of beans, pease, etc., is very frequent, it is necessary in preparing the proteïd substance from seeds to first remove the shells. The incomplete solution in salt water of the legumin present in seeds proves that the latter is a mixture of several proteïd bodies. The constituent of pease, soluble in salt water, does not differ essentially in composition from the body extracted by the aid of aqueous potash, and is very similar to the conglutin of lupines, although not identical with it, as the following figures will show:—

		Conglutin.
C	51·62	50·16
H	6·96	7·03
N	18·26	18·67
S	0·33	1·07
O	22·83	23·07

—E. G. C.

On the Influence of the Electric Light on the Development of Plants. P. P. Dehérain. Biedermann's Cent.-Blatt. 1883, 6, 408.

THE author's experiments were made with plants continuously exposed for many days and nights to the rays of the electric light, which in some cases were allowed to fall directly upon the plants and in others were caused to pass through the sides of transparent glass globes. Experiments in this direction had been previously made by Siemens, but not for such extended periods. The effects of the naked rays noted by Dehérain were very curious; some of the plants lost their leaves, some became spotted, weak and unhealthy, others turned black, while in the case of some elder shrubs, leaves directly exposed to the electric rays were blackened, although the more protected leaves retained their green colour. The outlines of the upper leaves were found in many instances depicted on those underneath with the distinctness of photography. The influence on vegetation of electric rays which had passed through transparent glass globes was not so prejudicial, although complete development was greatly interfered with. The following conclusions were arrived at by the author: (1) the electric light contains rays which are injurious to vegetation; (2) the greater part of these rays are kept back by transparent glass; (3) the electric light contains, on the other hand, sufficient rays useful to vegetation to maintain the life of plants entirely under its influence for 2½ months; (4) this amount of useful rays is, however, insufficient to bring on young germinating plants or to bring full-grown plants to maturity.—E. G. C.

Defects in the Present Method of Butter-making. Otto Biedermann's Cent.-Blatt. 1883, 6, 417.

THE author calls attention to several imperfections in the production and working of milk for butter-making. The

animals yielding the milk should be rationally fed ; for example, the food given to them must not contain a disproportionately large amount of any one ingredient, to the exclusion of others. Then, again, the milk yielded by old milch-kine is slightly bitter and furnishes bitter butter ; too much of such milk should therefore be avoided. Particular care must be taken that the air of the cowhouse be as pure and sweet as possible, and that no milk be allowed to remain there for a longer time than is absolutely necessary. The churn also should be in an airy and well-ventilated position, and all vessels used must be cleansed with the most scrupulous care. Neglect of any of these points involves a risk of the production of butter unsatisfactory in quality and in taste.—E. G. C.

Improvements in the Treatment with Sanitary Objects of Human Excreta and other Putrescible Matter ; and in Apparatus and Means employed in the Conversion of the same for Manurial Purposes. Richard Nichells, Hendon. Eng. Pat. 94, January 1, 1884.

THE fœcal matter is to be received in a vessel provided a removable air-tight hollow cover, charged with soot or other carbonaceous material, which falls upon and deodorises the excreta when the cover is re-placed by a person using the apparatus. The receptacle is constructed so as to be readily portable, and is adapted for being heated over a stove, with the object of partially or wholly driving off the moisture from the contents, which, after this firing process, are of high value for manurial purposes.—E. G. C.

Treatment and Disposal of Sewage. Fritz Hille, Chiswick. Eng. Pat. 1279, January 11, 1884.

THIS invention consists essentially in treating sewage with magnesium, calcium, ferric, or other chloride, or with calcium oxychloride, or with alum followed by lime-water ; the effluent water so produced being sufficiently purified for discharge into rivers or the sea. Where particularly strong and offensive sewage has to be dealt with, a small quantity of diluted carbolic acid may be added with advantage. The sewage deposit may be dried, crushed, and compounded with kainite, or with phosphate of lime, and profitably disposed of as artificial manure.—E. G. C.

Treatment of Sewage. J. B. Mills, Southampton Buildings, London, W.C. Communicated by Jean Marie Guénantin, Rue d'Hautville, Paris. Eng. Pat. 2568, February 1, 1884.

A SPECIAL re-agent is prepared by dissolving 4 parts bauxite in 50 parts hydrochloric acid by the aid of a jet of steam, and adding 30 parts phosphate of lime. This re-agent is mixed with the solid or sludge matters of excreta or sewage in closed vessels, and the mixture is dried, filter-pressed, and ground, forming a manure containing 3-4 per cent. nitrogen, and 8-12 per cent. assimilable phosphoric acid. The liquid portion of the matter to be dealt with is heated, mixed with lime, and the ammonia distilled off, all in a special arrangement of apparatus claimed by the inventor. The heated liquor, deprived of ammonia, is cooled by traversing a circulatory apparatus containing fresh liquor from which the ammonia has to be extracted. Various detailed processes are claimed, and a drawing is given of a complete arrangement of vats, precipitating tanks, heaters, stills, etc., for dealing with the excreta of a town.—J. M. H. M.

Dissolving Leather for use as Manure. By William Martin, Wadebridge, Cornwall. Eng. Pat. 3493, February 18, 1884.

LEATHER chips or shavings are mixed with potash, soda, lime, or other alkali, and heated by steam at 20 to 40lb. pressure, for 20 to 60 minutes, then dried and ground.
—J. M. H. M.

Recovering Nitrogenous Matters from Certain Deposits. J. C. W. Stanley, 41, Barnsdale Road, Middlesex. Eng. Pat. 1843, February 21, 1884.

RIVER mud collected in the vicinity of sewage outfalls contains a considerable proportion of nitrogen. Mud dredged from the still waters of the London Docks contains, according to the inventor, ·47 per cent. N. The inventor proposes to dredge up river mud, dry it, and submit it to destructive distillation in order to recover this nitrogen in the form of ammonia.—J. M. H. M.

Making Sewage Refuse into Manure. F. G. Redman and J. Butt, Peterborough. Eng. Pat. 3996, February 27, 1884.

IN the process patented for the conversion of sewage into manure, solid sewage refuse is treated with lime and sulphuric acid, employing for a ton of refuse 5 to 10cwt. or even a ton of the former and a carboy (about 60lb.) of the latter; several superincumbent layers are constructed in the order—sewage, lime, sprinklings of acid, finishing with a final covering of sewage. The resulting mass is mixed, for every ton of sewage employed, with 14lb. ammonium sulphate, 14lb. to 28lb. each of potash and kainite, and, if desired, 14lb. sodium nitrate; these quantities are, however, regulated according to the quality of manure required, and the introduction of the last ingredient is quite optional.—D. A. L.

Mill for Grinding Phosphates and other Materials. Isaac Brown, India Buildings, Edinburgh. Eng. Pat. 9457, June 26, 1884.

A HOLLOW drum is driven at a high speed and the material to be ground is fed into it through the trunnions. In contact with the inside surface of the rim of this drum are small rollers which effect the grinding. The rim may be perforated or reticulated. A drawing is annexed to the specification.—J. M. H. M.

An Improved Method of Purifying or Disinfecting Sewage, and of Collecting the Ammonia, etc., contained therein, for Manurial Purposes. S. D. Cox, New Charlton. Eng. Pat. 12,345, September 12, 1884.

ACCORDING to this invention, sewage is conducted from the sewers by means of pumps into a tank provided with several rows of plates or walls so arranged as to break or interrupt the flow of the sewage through, and to cause the greater part of the insoluble or heavy matter to become deposited at the bottom of the tank. The liquid portion is then allowed to flow over into a second tank containing a number of strainers or frames filled with peat or other suitable material. These strainers permit the liquid sewage to pass through them very rapidly, becoming, in its course, so purified that it passes from the second into the third tank in a comparatively clear condition. The third tank possesses a perforated false-bottom, on which is a layer or filter-bed of coarse peat-charcoal covered by another layer or bed of powdered or granular charcoal. These beds are about 6in. thick and provided with a perforated iron cover. After passing through these filter-beds the liquid will be bright and clear, and may be allowed to flow into a river or elsewhere.
—E. G. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

On the Formation of Sugar in Roots. Dingl. Polyt. Journ. 255 [1], 46.

GIRARD, in the *Comptes Rendus*, 1884, 99,808, has shown that saccharose is formed in the leaves of sugar-beets by the action of light and then passes into the roots. The proportion of saccharose to glucose is always much greater in the daytime than at night, sometimes being as great as four times as much. The formation of saccharose takes place in the leaves even when severed from the plant.—S. R.

Working up Diffusion Residues from Sugar. Dingl. Polyt. Journ. 255 [3], 127.

IN order to remove water as much as possible from the colloid matter in the cuttings, M. Maercker, of Halle

(Germ. Pat. No. 29,640, March 2, 1884), adds lime. Either caustic lime, slack or quick, powdered lime, or milk of lime may be used, also carbonate of lime. The addition of lime may take place without warming or the mixture may be warmed. It is stated that pressed cuttings containing 10·9 per cent. dry matter, when treated with ·5 per cent. of lime were, by a second pressing equal to a few atmoshperes, converted into a mass containing 25 to 30 per cent. of dry matter. The same pressure applied to cuttings not treated with lime gave only 15·6 per cent. dry matter. The addition of lime can take place in the presses or in the diffusers. No considerable removal of nutritious matter from the cuttings is observed, and owing to the small amount of lime added the dry matter contains but a small percentage more lime, which is not injurious and indeed rather beneficial as regards keeping properties and action of the cuttings as food for cattle; also the press-waters are removed in a much purer condition. Besides, by means of lime and carbonated and caustic alkalies, the introduction of osmose processes causes a large proportion of the water, which is tenaciously retained by diffusion residues, to become removable, and for this purpose common salt or other easily soluble salts of alkalies and alkaline earths may be employed. This process is applicable to the removal of water from other sugar residues, also from the residues of distilleries, starch manufactories and breweries, which are used for feeding cattle. Further, it may be employed for removing water from very damp materials used for fuels such as tanner's waste and especially turf.—H. A. R.

New Apparatus for the Manufacture of Sugar. Dingl. Polyt. Journ. 255, 202.

For estimating the soil on beets and potatoes, P. Reus (Germ. Pat. 25,755, April 3, 1883) employs (Figs. 1 and 2) a trough *d*, which can be raised and lowered on the cast-iron stand *a* by means of the lever *f*. The beam *b* carries at one end a weight pan, and at the other a washing drum, which dips into the trough *d*. The roots are placed in the drum, their weight determined, then the

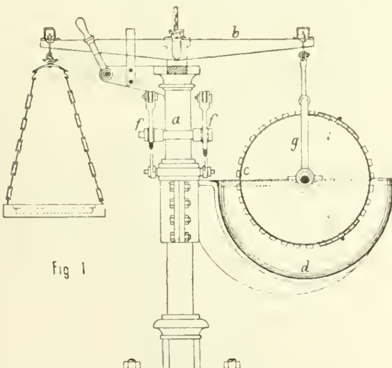
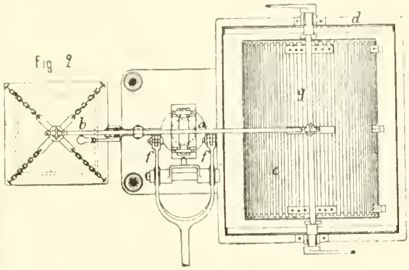


Fig 1

trough is raised, and by turning the handle of the drum the roots are washed. After lowering the trough and letting the water drain off they are weighed again, and the loss in weight corresponds to the amount of adhering soil.

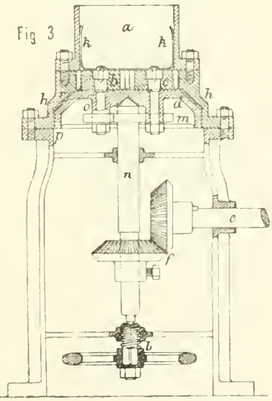
P. Suckow & Co., Breslau (Germ. Pat. 25,207, February 27, 1883), have devised a mill for preparing beets for analysis (Figs. 3 and 4). The roughly cut roots are thrown into the box *a*. Motion is imparted to the millstone *d* by the shaft *c* and the bevelled wheels *f*. The stone rotates in the cylindrical part of the case *h*, which is provided with teeth on the inside. On this two spur wheels work, and effect a complete grinding and crushing of the beet chips. When the chips are properly prepared they fall into the space *r*, in which they are reduced to the desired thin pulp, which is removed at *i* by a scraper. The space *r* can be adjusted by turning the screw *b*. A scraper R rotates with the shaft *n*.

Fig 2



O. Licht, Sudenburg (Germ. Pat. 25,062, March 13, 1883), in order to facilitate the solution of sulphurous or carbonic acid during saturation of the beet juice, attaches movable sieves *a* of metal or wickerwork to the inside of

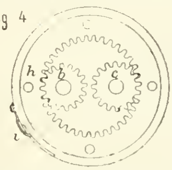
Fig 3



the vessel at *b* (Fig. 5), so that by means of the rods *d* they can be fixed in such positions as to give the desired resistance.

The juice filter of A. Vibrans (Germ. Pat. 27,362, June 21, 1883) is made of perforated sheet iron, and covered with a suitable filter cloth, so that the liquid contained in

Fig 4

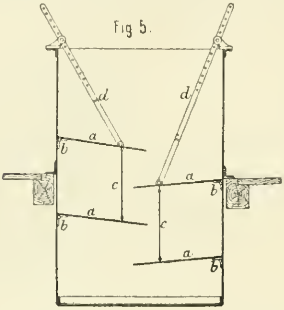


the vessel *a* (Fig. 6) passes from the out to the inside, and flows off by the pipe *d*, which can be readily removed by loosening the intermediate piece *c* when it is necessary to clean the filter.

In the juice filter of O. Licht (Germ. Pat. 27,364,

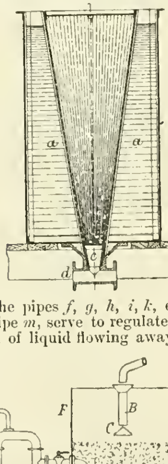
October 24, 1883), the liquid enters by the funnel-shaped pipe B (Fig. 7), falls on the distributor C, and thus on to the filtering material, which rests on the false bottom *s*. The filtrate passes through the pipes *a*, *b*, and *d* into the

Fig 5.



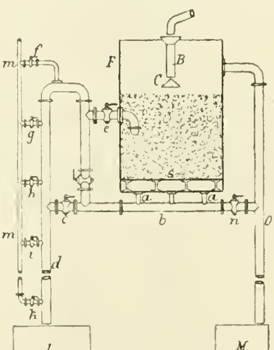
receiver L. The pipe *c* serves to discharge completely the liquid from the filtering chamber F, while the pipe *e* prevents the vessel from becoming empty during the

Fig 6



operation. The pipes *f*, *g*, *h*, *i*, *k*, connected with the common air pipe *m*, serve to regulate the suction height of the column of liquid flowing away, according to the

Fig 7



resistance offered by the filter to the passage of the juice. The pipe *n*, used for washing the sweet out of the filtering medium, opens into the overflow pipe O, which is connected with the vessel M. The filter is charged with juice by the pipe B, and the cocks *c* and *f* are opened; at first it works simply by the pressure corresponding to the difference in the level between the liquid in F and *d*, when the rate of flow diminishes owing to the filter becoming choked, the cock *f* is shut and *g* opened, whereby the outflow increases again. This is repeated from time to time with the other cocks. By increasing the length

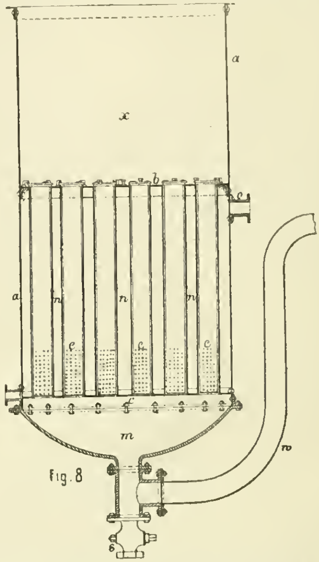
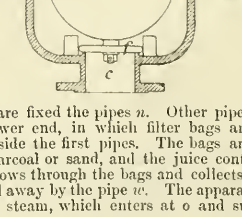


Fig. 8

of the suction pipe *d* almost any resistance in the filter may be overcome; when the filter is exhausted the cock *c* is opened, and the last portion of the juice allowed to flow out.

The bag filter of Th. Otto (Germ. Pat. 29,026, January 22, 1884) consists, as will be seen from Fig. 8, of a cylindrical vessel *a*, with two perforated plates *b* and *c*,

Fig. 9



in which are fixed the pipes *n*. Other pipes, perforated at the lower end, in which filter bags are hung, are placed inside the first pipes. The bags are filled with coarse charcoal or sand, and the juice contained in the space *x* flows through the bags and collects in *m*, and is conducted away by the pipe *w*. The apparatus is heated by waste steam, which enters at o and surrounds the pipes.

In order to prevent the steam from passing from the montejus into the filter presses, E. Schulze (Germ. Pat. 29,044, March 30, 1884) employs a vessel which communicates with the filter presses by the pipe C (Fig. 9), and contains a float *a*, to which the valve *f* is attached. The apparatus is started by raising the float by means

of the handle, when the vessel containing it becomes filled with the liquid to be filtered; after all the liquid has passed the float falls, shutting the valve *f* and preventing the steam from entering the presses, and opening the valve *g*, by which the steam escapes.

Figs. 10 and 11 show an apparatus (G. Bokelberg, Germ. Pat. 28,661, March 11, 1884) for drying beet roots

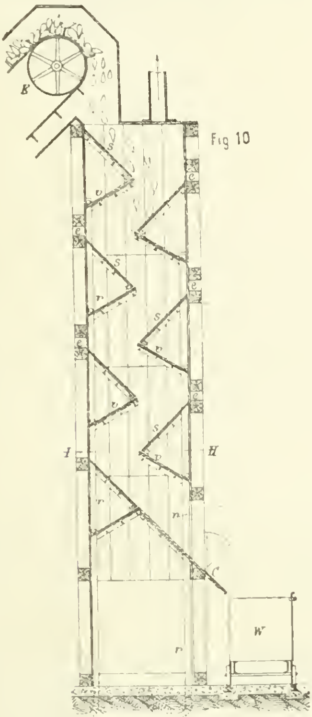
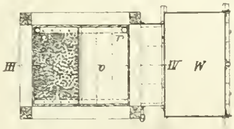


Fig 10

as they come from the washing machine. They are discharged into the drying apparatus, and fall on the sieve surfaces *s*, and finally discharge themselves at C into a wagon. The water adhering to the roots passes through the sieves and collects on the inclined plates *v*, and flows away by the pipes *r*. A blast of warm air passing up the apparatus completes the drying of the roots. The small doors *e* are to be used in the event of any

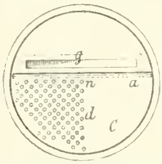
Fig 11



stoppage occurring in the drying apparatus, or for cleaning the shelves.

F. Rothe Söhne, Bernburg (Germ. Pat. 29,077, April 11, 1884). In order to increase the total section of the heating space in the vacuum pan, divide it into two parts by the divisional plate *a* (Figs. 12 and 13). The lower space C contains a number of horizontal pipes *d*, which open into the spaces E and F, and are connected with the upper part B by means of the elbow *g*. By using either the pipes *n* or the elbow *g*, which communicate between B and E, circulation of the liquid will take place in the direction indicated by the arrows. Steam is admitted into the space C, which is completely shut off from the liquid, and passes round the pipes *d*, which are full of the liquid, and along the lower side of the divisional plate *a*. It also heats the tube plates of the

Fig 12



chamber C, and communicates heat to the solution in the spaces E and F.

The circulation of the liquid in this apparatus greatly assists the evaporation.

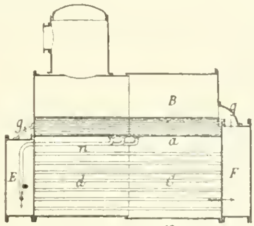


Fig 13

Fig. 14 represents another arrangement to keep the liquid in continual motion during evaporation in a vacuum pan, and is the patent of J. P. Liebe, Dresden (Germ. Pat. 27,614, October 19, 1883). A knee pipe *a* is fixed to the bottom on the pan, having a valve *c* to which the T-pipe *i* is attached. The pipe *e*, closed at the top,

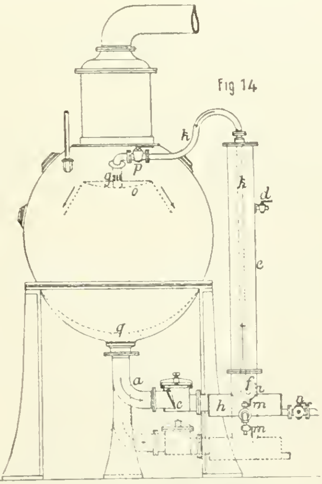


Fig 14

surrounds the tube *k*, one end of which *q* opens into the vacuum pan, while the other terminates as shown in the T-piece *i*. When the stop-cock *p* is opened, the air pump is started, and the solution to be evaporated is allowed to enter by *n* until it reaches *q*. The cocks *n* and *p* are

now shut, and the vacuum destroyed by opening the cock *d*. By shutting *d* and again opening *p*, the solution standing over *f* is drawn through *h* in the vacuum pan, then another portion of the liquid passes through the valve C into *i*, from which it is drawn again through *h* into the pan. The liquid is thus caused to circulate intermittently. If it be desired to make a continual discharge at *g*, the arrangement of pipes *a* and *h* are placed lower, as indicated by the dotted lines. By partially opening the cock *n* a continuous feed will be maintained. —W. M.

On the Production and Examination of Starch. Dingl. Polyt. Journ. 255, 209.

In the *Zeitschrift für Spiritus-industrie*, p. 762, 1884, O. Saare gives the results obtained in a factory where the process was conducted without grinding, the potatoes being passed through a rasping machine. Two experiments were made with 4800kg. washed potatoes (I. Seed ; II. Zwiebel), and these quantities were worked into starch giving : —

	I. Kg.	I. Per cent.	II. Kg.	II. Per cent.
Wet pulp	1,786	37·2	2,381	47·5
Dry pulp	—	4·6	—	5·7
Green starch	1,213	25·6	1,233	25·7
Dry starch	—	13·3	—	13·0
100kg. potatoes gave starch in the pulp	2·96	—	4·05	—

The following figures show a comparison between the yield obtained when only a rasping machine is used, and when, in addition to this, grinding is employed, from 100k. of starch worked :—

Starch.	Seed.		Zwiebel.	
	Without Grinding.	With Grinding.	Without Grinding.	With Grinding.
Obtained in form of green starch	81·8	87·4	76·3	85·5
Lost in the pulp	18·2	12·6	23·7	14·5

This table shows the advantage attending the employment of grinding for increasing the yield of starch. It should be noted, however, that the factory with the grinding plant employed a rasp cutter, while in the other case a rasping machine was used, which does not disintegrate the material so finely.

According to L. Bondonneau, errors are made in the estimation of the total solids in starch, when damp starch is heated to quickly over 60° C. When the starch contains acids, sugar is formed during the drying. He recommends the starch to be spread in a very thin layer, heated slowly to about 60° C. for three hours, then kept at 100° C. for one hour. If the starch be acid he adds a few drops of ammonia and water, and proceeds as before.

On the other hand, Saare (*Zeitschr. für Spiritus-industrie*, 595, 1884) heats 10grm. starch to 40° or 50° for one hour, and then keeps it at 120° for five or six hours. Numerous experiments have shown that for commercial analyses five or six hours' drying at 120° suffice to drive off all the water. He also says that the error caused by the conversion of starch into glucose, when starch having an acid reaction is dried, can be safely neglected. The amount produced when the starch contains ·1 per cent. of sulphuric does not influence the estimation of the water, consequently there is no need to add ammonia to acid starch.

S. Schubert (*Monatshefte für Chemie*, p. 472, 1884) has investigated the behaviour of starch granules on being heated, and concludes that changes in form and structure, especially the lamination, are not solely determined by the amount of moisture in the air-dried granules, but depend on the different physical and chemical properties of each layer. The effect of heat is simply to make these differences more prominent. The starch granule, under the influence of high temperature, is altered in such a manner that the layers, rich in granulose*, are at once converted into soluble starch and dextrin, while the principal portion of the layers, rich in cellulose only, undergo this transformation after a time. When starch which has been heated is treated with water of the ordinary temperature, the soluble starch and dextrin are removed, and an organised residuum is left, which resembles the form and structure of the original granule, and contains small quantities of unchanged granulose. This can be further removed by extracting with water, and it appears to be so altered that it can be easily subjected to chemical changes. The granules give up the greater portion of the granulose to the water, thereby losing in mass but not in volume, retain their structure, and consist chiefly of cellulose.

Granules extracted in this way become coloured blue, or, at least, bluish violet, on the addition of sulphuric acid and iodine, and the individual layers swell up and separate from one another. When the granules are heated more strongly with a drop of water, on the object glass, a deep blue colouration ensues. The residue is not a uniform body, but contains, in addition to cellulose and granulose, a transformation product of starch similar to dextrin which reduces Fehling's solution, is coloured red by iodine, and undergoes decomposition on treatment with water. At present it cannot be decided whether this body is urythrodextrin or not. If a large quantity of the granules be triturated with pounded glass, the substance yielding the red colour cannot be removed by repeated treatment with cold water, which presumably would not produce decomposition or alteration ; on the contrary, by the addition of iodine the residue becomes more intensely coloured, while the rotatory power remains practically unaltered.—W. M.

Preparation of a Substitute for Caoutchouc. Dingl. Polyt. Journ. p. 255, 215, 1885.

According to J. Haug and C. Hoffmann, St. Petersburg, a substitute for caoutchouc is made by washing the skins of hares, rabbits, and other small animals in water, removing the hair in lime-water, and then boiling them, along with 5 per cent. commercial glycerine and a small quantity of water, in a Papin's digester until solution takes place. A thick tough mass results, which can either be dried on wire nets or immediately worked up further. Twelve parts of this mass are melted, along with twelve parts glycerine, in a water bath, and then one part of a concentrated solution of bichromate of potash is added. The liquid mass is poured into moulds, and allowed to harden under pressure. This mass resembles vulcanised rubber, and can better withstand heat.—W. M.

Recovery of Waste India-Rubber. A. Gutensohn, London, and A. Cox, Bristol. Eng. Pat. 1994, January 23, 1884.

The scraps, cordings, India-rubber cloth and so on, are first classified into three groups : (*a*) those containing iron and steel, (*b*) those in which the adherence of the rubber to the cloth is not great, and (*c*) those in which the adherence is considerable. Group (*a*) is put in a solution of copper, such as sulphate or nitrate of variable strength, according to the material to be treated, the iron dissolved and copper is precipitated. The pieces of fabric are then added to (*b*) or (*c*) as the case may be. Group (*b*) is placed in hot water containing a little ammonia. After a short time the rubber can be easily stripped from the cloth. Group (*c*) is placed in a bath of ammonia diluted with water to a degree variable with the character of the pieces treated. In two or three days, more or less, the rubber can be easily stripped.—J. T.

* *Note by Abstractor.*—The author does not state precisely what the term granulose should include, but from the context it would seem to signify the substance of starch granules other than cellulose.

Improvements in Apparatus for Mixing and Elevating Sugar in Course of Process. J. H. Johnson. Communicated by "La Compagnie de Fives-Lille," of Paris, France. Eng. Pat. 2344, January 29, 1884.

THE apparatus constituting this invention is principally applicable to the mixing and elevating of sugar in the state of massecuite and other saccharine products, prior to their treatment in the centrifugal machine or turbine, but is applicable for treating other pasty or semi-fluid materials. "The employment of the said mixing and elevating apparatus is attended with considerable advantage in the manufacture of sugar, as the expense of conveying the sugar from the backs to the centrifugal apparatus is entirely obviated, the mixing apparatus being arranged to receive the sugar directly from the backs or other receptacles, and to mix, elevate, and deliver it directly to the centrifugal apparatus. The materials are thus transferred from one apparatus to the other without the intervention of hand labour, and without the waste which ensues during the operation of charging the centrifugal machine by hand. The improved apparatus enables the materials that are to be treated in the centrifugal machines, or turbines, to be mixed and elevated with facility and economy, and may be either permanently fixed in the vicinity of the backs or receptacles containing the said materials, or mounted on wheels so as to enable it to be readily moved from place to place." The apparatus consists essentially of a forcing apparatus, or pump, acting in combination with a mixing cylinder, which stirs and mixes the materials and reduces them to a state fit to enable them to pass readily through the pump. "The apparatus can stand at a very small elevation from the ground, and consequently admits of being fixed and charged with great facility. It occupies but little space, and the cost of its construction is not great." When the apparatus requires to be moved frequently, in order to be brought up close to the backs, or receptacles, containing the massecuite or materials that are to be mixed and elevated or transferred to the centrifugal machines or other apparatus, it is preferably mounted on wheels and actuated by a small independent engine, supplied with steam either by means of a pipe capable of being readily connected and disconnected with or from steam supply pipes of the works, or by a small independent boiler attached to the apparatus. —H. A. R.

A New Colour Starch. Emil Capitaine, London. Communicated by Drumm & Co., Kaiserslautern. Eng. Pat. 5260, March 21, 1884.

THIS invention consists in mixing with starch in the course of its manufacture any suitable brown or yellow colouring matter, so that when an aqueous solution is made of this colour starch, it simultaneously, with the starching operation, communicates a cream colour to goods steeped therein. Any required shades can be readily obtained either by mixing varying quantities of the colouring matter with the starch, or else by making the starch very strongly coloured in the first instance, and then adding the necessary quantity of ordinary white starch.—W. M.

Improvements in Gloss Starch. W. H. Carman, of London. Communicated by Wendel Zwick, of Newmühle-Albersweiler, Germany, starch manufacturer. Eng. Pat. 12,326, September 12, 1884.

THE following mixture is claimed as a substitute for borax in giving a gloss to starch or linen. It is stated that the action of borax is very detrimental. The inventor takes from 2 to 8lb. of white wax, stearine or spermaceti according to the gloss required, and perfumes with about 20 drops of otto of roses, fennel oil or oil of aniseed (or any other suitable essential oil). The melted mixture is then treated with about half-a-pound of caustic soda lye of 10°. After some further boiling, the melted mixture is diluted with about 4 gallons of water. "The above quantities are about sufficient to make 2cwt. of gloss starch." The fluid is mixed with the starch in a half-dry state, and the water is removed in drying pans. The wax, stearine or spermaceti, and the volatile oils remain with the starch, which is dried and treated in the usual way. Besides the gloss said to be imparted, the inventor claims a beneficial action of the above mixture on the fabric.—H. A. R.

Process for Extracting and Saccharifying Ingredients of Amylaceous Substances by Treatment with Malt. John Imray, Chancery Lane, London. Communicated by Leon Cuisinier, Paris. Eng. Pat. 14,271, October 22, 1884.

THIS specification contains much detail for the treatment of amylaceous materials, by which the starch is converted into dextrin, maltose and soluble substances, for use in the brewery, distillery or syrup factory. The claims bear especially upon a maceration in presence of malt and subsequent heating to a temperature not exceeding 75° C., by a source of heat also not exceeding that temperature, whereby the starch is converted mainly into dextrin. A further addition of malt to the liquor cooled to 50° C. carries the conversion into maltose and readily fermentable sugars.—W. M.

A New or Improved Manufacture of Filtering, Disinfecting, Deodorising and Decolourising Medium. G. H. Ellis, Exeter. Eng. Pat. 14,774, November 8, 1884.

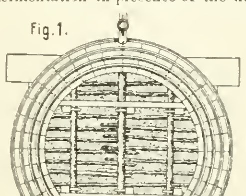
LIGNITE or Bovey coal, found in the Bovey basin, near Bovey Tracey and Newton Abbot, in the county of Devon, and containing, when calcined, from forty to eighty per cent. of siliceous matter, with a small quantity of alumina and iron, is subjected to a red heat in retorts and superheated steam introduced, which has the effect of removing the volatile hydrocarbons more readily, and also of extracting portions of the sulphur. The residue is transferred to tanks, and allowed to cool. It is then ground to powder as may be required, or it may be quenched by throwing water over the carbonised material immediately it is withdrawn from the retorts. The material known as "deads," found in association with the lignite beds, and consisting of an admixture of carbonaceous matter and detached particles of lignite, with clay, is treated in a similar manner. This filtering material is said to possess the following advantages:—(1) It is superior to animal charcoal for water filtration, inasmuch as it is free from calcium phosphate. (2) It does not favour the growth of the lower forms of animal life, but is an active agent in their destruction. (3) It is valuable for the filtration of acids. (4) It can be manufactured and supplied at less than half the price of animal charcoal. (5) It is a good deodoriser and decolouriser; and (6) it can be used with economy and advantage for sugar refining, as it causes less waste, in consequence of retaining less of the saccharine matter.—D. B.

XVI.—BREWING, WINES, SPIRITS, Etc.

Perret's Wine Fermenting Vat. Dingl. Polyt. Journ. 254 [12], 486.

MICHEL PERRET recommends a process introduced by him with success twenty years ago, for avoiding the evils attending fermentation in presence of the husks. The

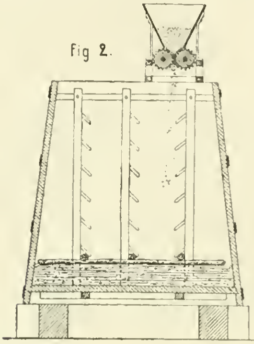
Fig. 1.



husks tend to rise to the surface of the must, giving rise to acetic fermentation, and a higher temperature in the upper portion of the vat. Perret's vat provides that the

husks are kept in fairly equal distribution throughout the progress of fermentation. To do this, it is fitted with vertical supports, carrying pins inclined downwards, whilst hurdles are laid in horizontally, which rise with the must during the filling, but are kept submerged at

Fig 2.



different depths by the rows of pins. The husks are arrested in their ascent by the hurdles. When the wine is run off, the husks and hurdles come down together, the latter falling readily on account of the downward inclination of the pins.—G. H. B.

On the Amount of Extractive Matter in Wines of the Year 1882. A. Heneeke. Biedermann's Cent.-Blatt. 1883, 6, 424.

According to the author, the wines of the year 1882 contained exceptionally small proportions of extractive matter, sugar and alcohol, this circumstance being explained by the fact that the vintage was by no means a good one, large quantities of the grapes being more or less unsound.—E. G. C.

The Preparation of a New and Improved Substance to be used in the Manufacture of Alcohol. Herbert John Haddan. Communicated by Constant Coster, Brussels. Eng. Pat. 2330, January 29, 1884.

Slices, pulp, or juice of Jerusalem artichoke, is submitted to the action of acids, sulphuric by preference, or *malt!* When acid is used a steam pressure of from 1 to 3 atmospheres is employed according to the quantity of acid, but the material is heated under a pressure of 3 atmospheres, then cooled to 50° C. before it is submitted to the action of malt. The syrup obtained is called "glucose of Jerusalem artichoke," and is said to be completely fermentable in 12 hours. The improvement claimed is the saccharification under pressure, and the preparation thereby, of a syrup richer in alcohol-yielding matter, and more rapidly fermentable than is obtained by the process called the "Procédé Champonnois."
—C. O. S.

Improvements in the Process of Fermentation and in the Manufacture of Alcohol, Beer, Wine and the like. Johan Henri Loder. Eng. Pat. 8800, February 4, 1884.

These improvements consist in adding various substances such as aniline, orthomonoamidophenol, sulphocyanide of potassium, etc., to fermenting liquids.—C. O. S.

Improvements in the Process of Fermentation in order to Prepare Alcoholic Solutions of Colouring Matters. Johan Henri Loder. Eng. Pat. 2666, February 4, 1884.

Nitric acid, trinitroresorcine, orthomononitrophenol, with sulpho-cyanic acid, aniline and sundry such things are added to fermenting liquids, and it is claimed that alcoholic solutions are thereby obtained which may be employed for the fabrication of wines—red, white or sparkling ones—and by distilling them for the fabrication of an alcohol containing aromatic principles; they may serve to prepare vinegar (*sic.*) or also for dyeing purposes.—C. O. S.

Improvements in the Treatment of Grain or other Materials for the Production of Alcohol therefrom. G. Epstein, London. Eng. Pat. 6557, April 19, 1884.

The patentee aims at conducting the operation of mashing and distilling in a continuous manner. He also states that he has found it more advantageous to work with a strong wort than with a weak one; a density of from 30° to 50° on Sykes's saccharometer gives results. The mashing is conducted in the usual manner, and either acid or diastase may be used. The apparatus specified consists of three parts: (1) the converting vessel provided with a stirrer and steam coil, (2) a straining and cooling vessel, (3) a fermenting vessel. The mode of working is as follows:—After the grain has been mashed it is allowed to descend into the cooling vessel, in the upper part of which is a straining plate; when the temperature has reached the proper point it is run into the fermenting vessel, which is closed to the air, and fermentation commenced; the air requisite to the operation being supplied by a pump. When the attenuation has proceeded far enough, it is forced by the pressure of the carbonic acid gas, given off during fermentation, back into the converting vessel, fresh material is added and another mashing operation started. The alcohol distilled off by the elevation of temperature passes into the rectifier, and the operation first described is repeated. If acid be used for the mashing, the quantity used in the second mash may be smaller than in the first stage. The patentee claims generally the process as described.
—C. C. H.

An Improved Method of and Apparatus for the Preparation of Malt. Henri Seney. Eng. Pat. 6620, April 21, 1884.

The grain is steeped in the usual way, and then distributed on rotating endless "aprons" made of wire gauze, placed one above the other in a series of four, and overlapping each other alternately. The thickness of the grain is regulated by adjustable registers, placed above the apron, and at right angles to the direction of its motion. The grain distributed on the top apron is carried forward, and falls on to the next below; this again carries it onward, and allows it to fall on the third apron, and so on until the fourth is reached; from this it is taken up by elevators, and again distributed on the top apron, and the process continued until the germination is considered complete, when it is passed on to an elevator which carries it to the kiln. The apparatus is provided with a "sprinkler," by which the grain in falling from one apron to another receives the necessary amount of water in the form of spray. The claim is for the elevators, endless aprons, sprinkler, etc.—C. O. S.

Apparatus for Purifying Distilled Spirits. W. R. Lake, London. Communicated by the Cushing Process Company, Boston, U.S.A. Eng. Pat. 10,740, July 29, 1884.

In that class of apparatus in which the liquor is purified and matured, by forcing through it air previously purified and heated, much alcohol is frequently carried away from the condenser by the current of air. The present invention comprises a condenser preferably of cylindrical shape, immersed in a cooler charged with cold water by the port. The condenser is connected with a tank, which contains the spirit to be treated. Hot air is passed into the tank. The condensed spirit passes through holes, and returns back into the tank, whilst the air and uncondensible gases pass away by a pipe.
—J. T.

XVII.—FOOD PRESERVING, MEATS, Etc.

Process for Preserving Meat. Dingl. Polyt. Journ. 255, 215, 1885.

MIGNON and ROUART cool meat, fish, etc., in a Carré ice machine to 20°, then quickly transfer these articles to tinplate boxes, and solder them up. Each box has a wooden casing, and this again is enclosed in a vessel which is filled with a freezing mixture, and protected outside by a covering of wood and cork shavings. In one experiment 525R., out of an original freezing mixture of 1000R. were melted after 46 days, and the temperature in the middle of the freezing mixtnre had risen to 4°. The meat was perfectly good.—W. M.

Improvements in the Preparation of Salt, Saltpetre, Sugar, and other Antiseptic Substances for use in the Preservation of Food. E. Sonstadt, Cheshunt. Eng. Pat. 6304, April 12, 1884.

THIS invention consists in adding calcium iodate to any food preservative, or to any mixture of preservatives. The proportions may be from one per cent. up to five per cent., and it may be added in either the solid or liquid form. When the solution is used, the solubility may be increased by the addition of neutral sodium or potassium citrate. The claim is made for the application of calcium iodate in the preparation of antiseptic substances used in the preparation of food.—C. C. H.

Antiseptic Compound. William Hibbert, Clarence Street, Cheetham, Manchester. Eng. Pat. 13,358, October 9, 1884.

To one gallon of a solution of magnesium chloride, 50° T., add ½oz. magnesium bromide, ¼lb. common salt, and ¾lb. potassium sulphate. The same ingredients may be used in other proportions. The mixture is available for the preservation of meat, and other animal and vegetable substances.—J. M. H. M.

Improvements in or Relating to the Preparation of Beverages or Foods. W. H. Thew, Liverpool. Eng. Pat. 14,965, November 13, 1884.

THE object of this invention is to manufacture a preparation of condensed peptonised milk and cocoa, in which the flavour of peptonised milk is disguised, and the constituents of milk are enriched by the addition of the nutritious and stimulant principles of cocoa, in an easily digestible form, also a preparation of coffee and peptonised milk. The milk to be peptonised is heated to about 60° C., then a decoction of cocoa is added and bicarbonate of soda (½oz. per gallon), or phosphate of soda (½ to 2oz. per gallon). An extract of pancreas is next added, the mixture kept at about 60° C. for 1-2 hours. By the action of the pancreatic ferment, the insoluble constituents of the cocoa are rendered almost completely soluble. When the peptonising is finished, sugar is added and the liquid is boiled for a few minutes, to kill the ferment, and then concentrated in a vacuum pan, until it contains about 20 per cent. of water. In preparing condensed peptonised milk and coffee, an extract of coffee is added to the peptonised and sweetened milk, preferably during the later stages of condensation.—W. M.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

Spread of Cholera through the Medium of Water. Dingl. Polyt. Journ. 254, 444.

MAREY (*Compt. Rend.* 99, 667) shows from the cholera reports of the year 1832, 1849, 1850, 1854-55, that the spread of the epidemic in the various districts of France where the disease raged, is distinctly traceable to contamination of water supplies. This confirms the statements of Koch (*Dingl. Polyt. Journ.* 252, 261).—C. F. C.

Communication of Cholera by Drinking Water. The Medical Chronicle [6], 518-522. Abstracts from various Reports, etc., by Prof. J. Dreschfeld.

KOCH'S results have been already briefly given (see this Journal, iv. [1], 59). The investigations of the English Commission, as reported by Klein, have led them to the following conclusion, among others. There is direct evidence to show that water contaminated with choleraic evacuations, and containing, of course, the comma bacilli, when used for domestic purposes, including drinking, by a large number of persons, did not, in the case of the tanks near the Saheb Bagan, produce cholera. Dreschfeld remarks with regard to this evidence: "Against this negative evidence Koch would cite his positive evidence, as seen from his report." Pettenkofer speaks chiefly against the contagious nature of cholera, especially against its propagation by drinking water. His statement about the disappearance of the cholera from Fort William, with the improved drainage of the Fort, is contradicted by De Renzy, who clearly showed that the cholera disappeared with the improved supply of drinking water. Klebs, in his second paper, gives an interesting instance of the propagation of the cholera by contaminated drinking water. Genoa is supplied with water by the Acqua Nicolay, Acqua Galliera and the Civico Acquedotto. Of 270 cases of cholera, where the water supply could be determined with precision, 256 received their drinking water from the Acqua Nicolay—*i.e.*, 92 per cent. The workhouse, with 1200 inmates, is supplied from the Acqua Nicolay, but the supply was cut off immediately after the cholera broke out, and though the cholera raged in this district, by no means a very salubrious one, no case of cholera occurred in the workhouse. As to the source of the contamination, it was found that cholera cases occurred nine to ten days previous to the outbreak in Genoa in the small village of Busalla, situated near the mountain river Scrivia, whence the Acqua Nicolay draws its water supply; the bed of the river is very stony and the water very shallow, and it is well known that the inhabitants of Busalla dried their clothes on the stones standing out from this brook.—W. S.

Improvements in the Preparation of Agents to be used in the Treatment of Sewage and other Similar Putrescible Matters. W. C. Sillar and J. W. Slater, Kent and Middlesex. Amended specification. Eng. Pat. 1144, September 3, 1883.

THE inventors prepare crude chloride of aluminium or chlorides of aluminium and iron, for use in the purification of sewage, etc., in the following manner. An aqueous solution of sulphate of alumina (obtained, for example, by lixiviating with water any shales or other minerals containing sulphate of alumina either alone or together with sulphate of iron) is mixed with solution of calcium chloride, in equivalent proportions, the deposit of sulphate of lime then formed is used for manurial or other purposes, and the liquid—which consists, according to circumstances, of a solution of aluminium chloride or of the chlorides of aluminium and iron—is employed for the purification by precipitation of sewage, etc.—E. G. C.

A New Disinfectant. Alfred J. Shilton, Birmingham. Eng. Pat. 852, January 7, 1884.

THIS preparation consists of a solution in water of potassium iodide, iodine and chloride of ammoninm, the proportions being 2oz. of potassium iodide, 1oz. of iodine, and 16oz. of ammmonium chloride, to each gallon of water. The disinfectant may be diluted for use with 15 or 20 times its bulk of water, and either exposed to the air in shallow vessels or diffused by means of a spray producer.—E. G. C.

An Improved Compound for the Elimination of Dissolved Matter from Water. P. A. Maignen, London. Eng. Pat. 3038, February 9, 1884.

THE improved compound is the mixture, in a powdered form, of substances "of a differential order of action" to precipitate the salts in a water. The patentee states

that the consequence of the addition of such a mixture is the successive precipitation of the various inorganic bodies present, the reactions occurring seriatim, with a "slight overlap." The materials composing the mixture may be lime, alum or sulphate of alumina, etc., "calcined or ground soda or soda-ash"; but the proportions and the materials themselves may undergo variation "so long as they constitute a compound in a powdered state of chemical equivalents with constituents of differential order of action." The claims are: (1) The compound composed of the re-agents specified above with the alternative addition of permanganate of potash; (2) an alternative compound composed of "chemical equivalent in a powdered state acting upon the water in the same differential order as hereinbefore described."—C. C. H.

Improvements in and Relating to the Filtration and Purification of Water and means Employed Therefor. W. R. Lake, London. Communicated by J. W. Hyatt, Newark, New Jersey, U.S.A. Eng. Pat. 3593, February 19, 1884.

THIS specification describes a method and apparatus for the continuous purification of water. The process consists of injecting into the water, whilst on its way to the filtering bed, any substance, such as iron or salts of iron, which will coagulate the impurities succeeded by a re-agent—*e.g.*, lime or the alkaline earths which combines with the first re-agent and precipitates the excess of the iron. The water is then passed on to a bed of filtering material preferably composed of sand and communited iron; the precipitated matters are retained on the filter and the water issues from the apparatus bright and clear. The apparatus consists of a water meter, also actuating an automatic injector adjusted for forcing the proper amount of re-agents into the water and a vessel holding the filtering bed. The whole invention is covered by six claims.—C. C. H.

Improvements in Disinfecting Litter Powder or Compounds. J. Brown, Dewsbury. Eng. Pat. 5175, March 20, 1884.

IN order to prevent the spread of infectious diseases, such as "foot and mouth disease," among cattle the patentee manufactures a disinfectant litter by saturating sawdust, peat or other fibrous or absorbent vegetable matter with carbolic acid and creosote; fifty per cent. of the acid and five per cent. of creosote giving good results. The claims are: (1) The manufacture of a disinfectant litter from vegetable matter or porous earth by the addition of carbolic acid and creosote; (2) the use of the litter for the purpose set forth.—C. C. H.

Improvements in the Manufacture of Carbolate of Lime for Disinfecting and Deodorising Purposes. J. B. Austin, Bristol. Eng. Pat. 5447, March 25, 1884.

To produce a cheap disinfectant the spent lime from gas works is heated to drive off the sulphur, carbonic acid and other volatile products, which have combined with it in the purification of the gas. It is then combined with 25 per cent. or more of carbolic acid, producing a carbolate or sulpho-carbolate of lime. To produce a mixture of uniform composition it is passed through a disintegrator or other apparatus. The claim is the manufacture of a carbolic powder from the refuse lime of gas works treated as described.—C. C. H.

Improvements in Apparatus and Arrangement of Apparatus for Filtering Water and other Fluids. G. Weddell, Newcastle-on-Tyne. Eng. Pat. 6208, April 10, 1884.

THE filtering apparatus is constructed in two parts, the upper part receiving the unfiltered water and the lower part the filtered water. Between the two there is placed the filtering chamber; this consists of a cylindrical vessel packed with animal charcoal and covered at each end with paper, cotton, or asbestos cloth, the whole filtering medium being retained in place by perforated diaphragms of porcelain, glass, or other suitable material. The patentee claims as novel the filtering chamber, as described and arranged.—C. C. H.

Improvements in Disinfecting Powders. C. Lowe, Reddish. Eng. Pat. 6401, April 16, 1884.

A MIXTURE of refined carbolic acid, cresylic acid, or other coal-tar acids, in a concentrated state, is mixed with infusorial earth or "Kieselguhr;" such earths are capable of absorbing an equal weight of the acids named. The proportions usually employed are 40 to 75 parts of the concentrated acids to from 60 to 25 parts of the infusorial earth. This powder is specially suitable when heated in vessels for disinfection by the vapours of the acids. The patentee claims the manufacture of the powder as described.—C. C. H.

An Improved Method of Purifying Water Contaminated by Dissolved Vegetable Matter. A. Irving, Wokingham. Eng. Pat. 8056, May 22, 1884.

THE patentee states that the vegetable matter contained in a water is held in solution by means of certain organic acids. The removal of these may be effected by bringing the water in contact with metallic iron when the soluble salts of that metal are formed; exposure to oxygen at once causes the precipitation of the iron as the peroxide, the acids being resolved into carbonic acid and water to carry this into effect for small quantities of water such as used for domestic purposes. The specification shows a filtering apparatus consisting of a reservoir for holding the iron deep enough to contain sufficient water to keep it covered, a filtering bed of sand and gravel, an air chamber through which the water falls and becomes aerated, a conical piece covered with cloth to separate the oxide of iron precipitated by oxidation, and a receiver for the purified water. In operating upon large bodies of water the iron is brought in contact with it in shallow ponds or lakes, the required amount of oxygen furnished by causing the stream of water to fall over a succession of cascades, and the precipitation oxide of iron removed by filtration through beds of sand. The claims are (1) the process as described, (2) the small domestic filter, (3) the process for purifying large quantities of water as specified.

—C. C. H.

Improved Process for the Manufacture of a Mineralised Carbon for Filtering, Disinfecting, and other Purposes. J. W. Gatehouse, Bath. Eng. Pat. 9102, June 17, 1884.

THE inventor intimately blends with lignite (preferably dried and granulated) mineral matter containing large amounts of silica, either free or combined, such as felspar, diatomaceous earths, grit stones, sandstones, volcanic tufa, greenstone, siliceous clays, etc., in such proportions that the product obtained by distilling the mixture in suitable retorts shall contain from 20-60 per cent. of mineral matter, and from 80-40 per cent. of carbon, according to the purpose for which it is required.—E. G. C.

Improvements in the Collection, Treatment and Disposal of Sewage, etc. Donald Nicoll, Westminster. Eng. Pat. 10,275, July 17, 1884.

THE inventor calls his method the "Cloacina" system, and he collects the excrementitious refuse from dwellings in metal tanks of suitable sizes and shapes, each possessing a removable air-tight cover and containing two framed metal strainers (also removable) so arranged as to divide the tank into two compartments; one of the latter contains sand, grit, gravel or other similar material, and the other is filled with animal or vegetable charcoal. Each tank has an opening in the lower part of one of its sides, masked by galvanised iron-wire network, and serving for the escape of the effluent, which is "perfectly innocuous, and can be discharged with safety to the public health down any open ditch, sewer, river or watercourse." These tanks are to be placed, with their lids off, in subways faced with non-absorbent bricks and constructed in the footpaths or as near as possible to the dwellings, the sewage from which is to be received. Over each tank is a manhole of framed ironwork, coated outside with the usual paving of stone, metal, or asphalte, as the case may be. From time to time the manholes are opened and, by means of a funnel, dry earth, crushed

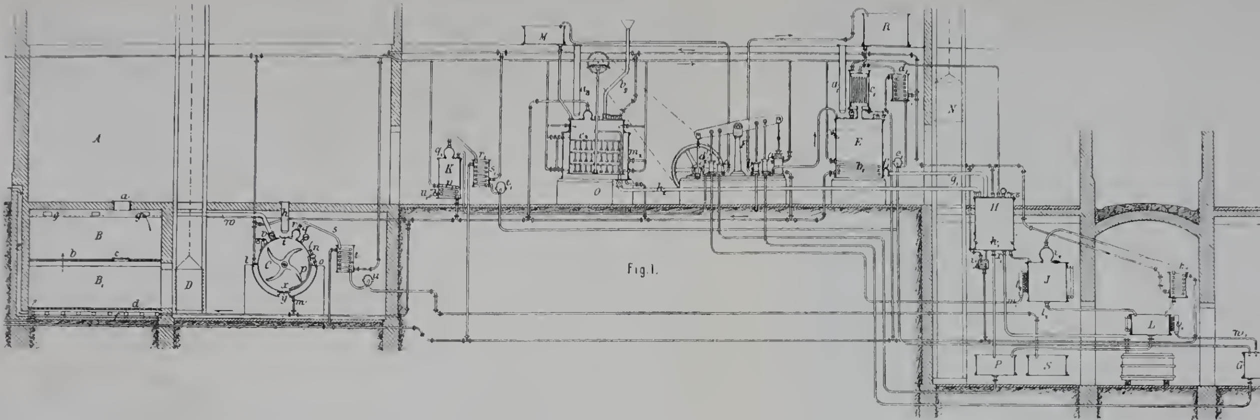


Fig. 1.

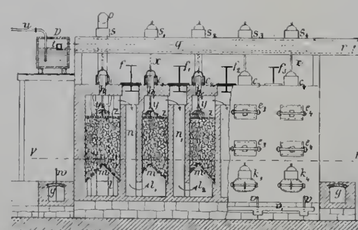


Fig. 3.

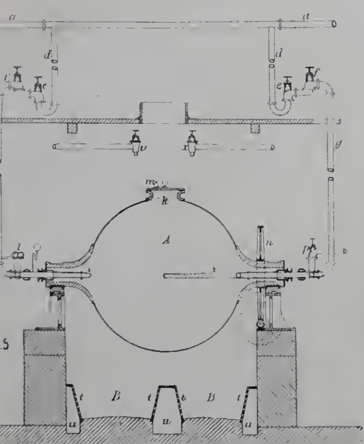


Fig. 5

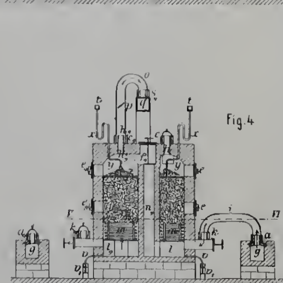


Fig. 4

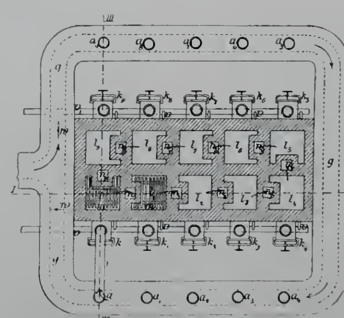


Fig. 2

burnt clay, street mud, lime, salts of alumina, sifted dry ashes, or soot, as may be preferred, can be shot down upon the matter in the tanks beneath. When sufficiently charged these are to be removed in wagons provided with cranes and hand-winches for the purpose of hauling the filled tanks out of the subway and replacing them by empty ones. During the removal of the charged tanks their air-tight covers are screwed on, and the lateral outlets before referred to are also closed by screwed lids. The wagons are furnished with flanged wheels, gauged for the nearest tram or railway, and with removable broad wooden tyres so that the operations of moving the tanks, depositing street mud, etc., can be carried on at night with as little noise as possible. A further part of this invention relates to the treatment and disposal of the sewage matter collected in the tanks, and consists in the construction of fireclay kilns, with double roofs, so arranged that offensive vapours pass through perforations in the inner roof and are conveyed back to the fire by a return or connecting pipe. The charged tanks are placed in these kilns for the purpose of drying, not charing, the contained sewage matter, which is thus solidified and rendered suitable for pulverisation and sale in the form of a powder, similar to that known on the Continent as "poudrette." In rural or thinly-populated districts pits are to be substituted for the above-mentioned subways, for the reception of the tanks.—E. G. C.

Hygienic Candles. A. Wright, London. Eng. Pat. 11,963, September 3, 1884.

TALLOW, stearine or other material used for making candles is mixed with 5-10 per cent. of oil of eucalyptus or cageput oil, or a mixture of these. In some cases a small proportion of carbolic acid may be added.—J. T.

XIX.—PAPER, PASTEBOARD, Etc.

Manufacture of Paper capable of Resisting Fire and Damp. Dingl. Polyt. Journ. 1884, 254, 315. Ger. Pat. 28,139, December 21, 1883.

W. HERRE proposes to add to the pulp during the process of grinding in the rag-engine solutions of certain salts which, by mutual decomposition, form insoluble compounds. The solution which is added first contains zinc sulphate, or chloride, or calcium chloride, or acetate, whereupon tallow, soap, glue, and alum are added. After having been thoroughly mixed the mass is formed into paper, which, however, before being dried is once more passed through a bath of the same, or similar, composition to the solution used for mixing with the pulp in the rag-engine, and ultimately impregnated with a solution of catechu.—F. M.

Preparation of Cellulose for Paper-making. Dingl. Polyt. Journ. 255 [3], 111.

A. BEHRIN COETHEN has patented the following process (Ger. Pat. 28,219, September 29, 1883) for preparing cellulose and glucose from wood: After being carefully barked and cleaned, the wood is reduced to shavings or sections in A (Fig. 1). The sections pass through a trap to a on the drying loft b, and are there subjected to preliminary desiccation, after which the wood passes through c on to the drying loft proper, B. The base of the same consists of perforated iron-plates. Canals e introduce fresh air under the base, which is heated by a system f of tubes fed with condensed water. Hot-air passes into B_1 and B, then through the loose wood drying the same, and finally escapes by the canals g to the flue. If the wood is subsequently to be treated with alcohols, it is necessary to remove turpentine from coniferous woods by a distillation at 160° C. By means of the hopper h, and the manhole i, the wood is passed into the iron cylinder C, which is furnished with an agitator.

The cylinder is jacketed in its lower half; and the jacket fed with steam of six atmospheres The subsequent drying of the wood takes place by means of the water which has been used for cooling the worms, etc. Water or steam is introduced by the cock l, and passes out by m. After closing the manholes and the cocks n, the cocks o are opened, until enough steam has passed in through p, which follows the side of the cylinder. The turpentine (b. pt. = 157° C.), mixed with aqueous vapour, passes through q, r, and s, to the cooler t, where the gases are liquefied, and flow into S. After all turpentine has passed over, steam and cock o are shut off, and n and v opened. The agitator brings the wood into contact with fresh air coming in through n and p, and escaping through v and w, into the flue. After being dried the wood is conveyed by means of D to the first floor, and thence into the boiler E, where it is to be freed from resin. When filled, two-thirds with wood, oil of turpentine, or fusel oil, is introduced from G by means of a_2 and F, so as just to cover the wood.

By means of b_1 the temperature is brought somewhat over that of the liquid contents, and an excess of pressure in the cylinder avoided by the cooler c_1. When all resin is dissolved the pulpy mass is conveyed into the extractor H, through f_1 and g_1. A false bottom h_1 allows of the removal of the resin solution by means of steam. In the receiver J, separation takes place, the resin solution forming the upper layer on the water containing extractive matter. The former is distilled in K, and the latter conveyed to the receivers R and M, over the glucose boiler. The pulp remaining in the cylinder, on the false bottom h_1, contains usually certain carbohydrates and salts insoluble in water; and in the case of coniferous woods the salts of iron present much impede subsequent bleaching. This pulp is conveyed into the glucose boiler O, and there treated with the required quantity of very dilute sulphuric acid. After boiling, the pulp is washed till free from acid. The waste liquor from this operation contains notable quantities of glucose; and is, therefore, also conveyed to the cisterns P. The pulp is then ready for bleaching, or else is pressed and dried.

W. Flodquist's process (Figs. 2, 3, and 4), according to *Papier Zeitung*, 1884, p. 1436, differs from other sulphite processes, mainly in the fact that the SO_2 passes over moist bones, which have been freed from fat, and so produces a solution containing bisulphite and phosphate of lime. The SO_2 passes through g, and with the trap w placed as in Figs. 2 and 4, follows the arrow-head through a, i and k, into the first absorption chamber l. Of 10 chambers two are supplied with bones, and eight with limestone. The action is continued until the solution in D has the required density of 5° B., for wood, which is reduced to 2·5° B. for straw. For particulars respecting the management of the apparatus, and the preparation of glue, etc., the original should be consulted, as these are incapable of useful abstraction.

The arrangement for preparing paper-pulp consists mainly, as shown in Fig. 5, of a spherical revolver, fed direct, at high pressure, and hence provided with a safety valve l. The boiler is made of steel plates lined with lead, which is affixed by means of screws provided with large lead-covered heads.

When pulping sawdust, the same is filled into about half the boiler, covered with the above solution, and then boiled for eight or nine hours, with a final pressure of about 70lb., and with four revolutions per hour. The boiled mass is then reduced as required. Wood is boiled similarly to sawdust. For straw, after chopping, comes a six hours' boil with the lye at 2·5° B.—H. A. R.

Improvements in the Manufacture of Paper. John Henry Johnson. Communication from Jules André, Meyrueis. Eng. Pat. 151, January 1, 1884.

THIS process, which does not appear to contain any novelty, consists in causing two webs of paper of different quality, while still wet, to combine together by pressure. Thus united, the duplex paper is dried and finished in the ordinary way. The specification is accompanied by drawings, showing how the method can be worked either with two cylinder machines or with a combination of a cylinder and an ordinary Fourdrinier machine.—E. J. B.

Improvements in the Manufacture of Paper, Paper Pulp, Pasteboard, Millboard and Papier Maché, and such substances applicable for Cabinet and all kinds of Structural Purposes. Eng. Pat. 2316, January 29, 1884.

THIS remarkable process consists in boiling peat, moss or wood fibre, in a liquid composed of potash, chloride of lime, quicklime, sulphuric acid and acetic acid. Pulp so prepared is bleached by a solution containing the above re-agents, together with sulphur.—E. J. B.

Improvements in Uninflammable Pulp for Paper. Baron Louis Moser Dulfus, London. A Communication from Julien Ponty, of Brussels. Eng. Pat. 3780, February 22, 1884.

THE object of this invention is to produce a material in itself uninflammable and incombustible, which, when applied to the manufacture of paper, etc., will render the same capable of resisting a fierce fire. This material is also to have the important property of constituting an insulating material for electrical conductors of all kinds, and to be not attacked by acids or corrosives. The principal constituents of this uninflammable powder are: (1), asbestos fibre, which is reduced and bleached in any convenient way; (2), fossil powder, which is a substance containing about 80% silica, 10% fossil wood, 5% lime and 5% iron, and which is bleached by chlorine or otherwise. This material, when crushed, is mixed with an equal quantity of "neutral" silicate of soda at 40° Bé. Besides its uninflammability, this light material has the property of rendering the paper soft to the touch, and of affording a good hold for the size, "as each particle is hollow." In some cases this material may be replaced by sulphate of alumina, or any other uninflammable material; (3), a pulp obtained from animal fibre—*e.g.*, waste silk, silk rep, or other materials having similar qualities as regards cohesion and felting properties combined with fineness of fibre, which will thus not flare up when ignited. A pulp from Baobab bark, which has these properties, may be substituted for the silk or other pulp. The proportions will vary according to the nature, etc., of the paper to be produced. For fine writings the following proportions are recommended:—

Asbestos	80-90%
Fossil powder	5-10
"Neutral" silicate at 40° Bé	5-10
Animal (silk) pulp	1·5

If the sizing to take place in the engine, 1% of the following "size" must be added:—

Water	130 parts.
China clay	100 ,,
"Neutral" silicate at 30° Bé	9 ,,

When the paper is to be tub-sized, the water and China clay will be 65 and 47 parts respectively, and 12 parts of resinous soap are added. For moulding ornaments direct from the pulp, or for coating electrical conductors, the proportions are somewhat altered, and a small quantity of cerosine added. The following proportions are recommended for such a case:—

Asbestos	70-80%
Fossil powder	10-15
Silicate at 35° Bé	5-10
Silk pulp	1-3
Cerosine	1-5

In applying this pulp for insulating wires, the coating varies from 1·5mm., and if the wires are submarine, some suitable non-putrescible material is added.—H. A. R.

Improvements in Means for Rendering Objects Uninflammable. Baron Moser Dulfus, London. A communication from Julien Ponty, of Brussels. Eng. Pat. 3786, February 22, 1884.

INFLAMMABLE objects, such as theatre decorations, are to be rendered uninflammable as follows:—The object to be rendered incombustible is covered with paper made according to specification No. 3780 of even date. This paper is affixed by means of a special uninflammable adhesive mixture, which is composed of 80-85 per cent. of sodium silicate of 40° Bé. mixed with from 10-15 per cent. of fossil powder ground fine. After two or three days the mixture is to be decanted and used.—H. A. R.

Improvements in the Method or Process of, and Apparatus for, Draining, Concentrating, Clarifying, and Consolidating or Solidifying Substances and Liquids, especially applicable for Filtering Paper Mill Sludge, and Consolidating the Substances contained therein. J. Foulis, Musselburgh, N.B. Eng. Pat. 4202, March 1, 1884.

THE object the patentee has in view is the separation of the solid from the liquid matter contained in a material such as the refuse waters from a paper mill. The material is first settled in tanks in order to eliminate as much of the water as possible. The residue is then submitted to pressure in a suitable apparatus, of which two kinds are described. The first kind of apparatus shown is similar to a paper-making machine; the sludge is fed on to an endless band and carried between rollers, the upper one bare, the lower covered with felt. The pressure eliminates a further quantity of water, which is absorbed by the felted roller, the solid matter adhering to the bare roller, and being scraped therefrom by a blade, is carried on to the next pair of rollers, where it is similarly treated. The second form of apparatus shown resembles a filter press with a single cell. A cylinder is fitted with a cover, the face is grooved and covered with felt, a piston fits the interior of the cylinder, the face of which is similar to the cover, and it can be drawn back or forced forward by a hydraulic ram; the material is admitted to the interior of the cylinder by a valve which does not permit egress of the liquid when pressure is applied. The cylinder being charged with the sludge by drawing back the piston, the pressure is applied and the water expressed out; on drawing back the piston, a second charge is admitted, and the operation repeated until a solid cake of the matter recovered is left in the machine. In some cases the liquid is heated before being subjected in order to coagulate the albuminous matters. —C. C. H.

Improvements in Apparatus for making Wood-Pulp. W. R. Lake. Communicated by C. Storey, of Providence, Rhode Island, and George E. Marshall, of Turner's Falls, Mass., both in U.S.A. Eng. Pat. 12,346, September 12, 1884.

THIS invention relates to the apparatus used in making wood-pulp, and comprises the following objects: Reduction in the cost of production, firstly by facilitating the operation, and secondly by reclaiming to a large extent the chemicals employed. Also the simplification of the process by rendering it more automatic than has hitherto been the case. Further to simplify the process of constructing the digestor used in the operation, and finally to provide the same with an improved lining which shall meet the requirements of the operation. In the present process for disintegrating woody fibre, by boiling under pressure. Sulphurous acid is used to dissolve the resinous and other cementitious matter enclosing the said fibres. The liquid in which the fibre is boiled is water, containing from one to four per cent. of sulphurous acid in combination with lime or magnesia in varying proportions. This liquid covering the fibres is heated in a jacketed boiler of a non-corrosive metal. A steam space is left in the upper part of the boiler. Whilst the boiling is proceeding large amounts of gases are produced, and which take up oxygen from the water, fibre and chemicals forming sulphuric acid which may injure the fibre by too violent action. Hence occasional blowing off is required, and this entails considerable time, attention and care, besides the gases being totally lost. Another difficulty lies in the sudden expansion of the gases by which the top-pressure in the digestor is increased, and the free circulation in the interior is interfered with. To avoid these difficulties and to prevent the loss of chemicals, the steam space of the digestor is connected with a condenser surrounded with cold water, and regulated by some form of a steam-trap or valve by which any liquid having condensed is automatically removed without any reduction in the steam pressure of the digestor. When blowing off the chemicals are reclaimed by a separate condenser connected with a tank fitted with stirrers by means of which the acid can

be again combined with any desired base, or be otherwise utilised. By this improved apparatus the pressure is gradually raised, but accumulation of gas and consequently of pressure avoided, the circulation made rapid, and hence all parts of the charge are brought under the action of heat and of the liquid. The burning or blackening of the fibre from the formation of sulphuric acid is also prevented. The chemicals not taken up by the cementitious matter are regained, the attention and labour required are reduced, and a superior and more uniform product than hitherto is obtained.—H. A. R.

Improvements in and Relating to Boilers for use in Treating Wood, etc., with Acids. H. H. Lake, London. Communicated by C. W. Flodqvist, Gothenberg. Eng. Pat. 15,188, November 18, 1884.

The object of the improvements is the prevention of the fracture of the lead lining of vessels used for this purpose, and which is due to the buckling produced by the unequal expansion between the lining and shell of the vessel consequent upon heating. Instead of making the lining, and the shell also, in one continuous piece as heretofore, in which case the difference of expansion reaches a maximum, the vessel is made up of a number of flanged pieces, made from steel, cast or wrought iron, each piece being covered with lead also beaten out over the flanges, the whole being firmly held together by bolts; thus forming one vessel with a continuous lining. The complete vessel is provided with lead lined covers fitted with manholes, and in some cases may be suspended on trunnions at right angles to its longer axis, gearing being provided for its revolution when necessary; one trunnion serving for the introduction of steam and the other for its exit. The claims are: (1) a boiler composed of a number of rings bolted together as described; (2) lining the rings with lead flanged over the joints so as to form a packing between the joints of the cylindrical rings.—C. C. H.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES.

Santonine Manufacture at Orenburg, Russia. Dingl. Polyt. Journ. 1884, vol. 254, p. 316.

The proprietors of the Santonine Works at Orenburg, H. Mauer & Co., contradict the statement made by C. O. Cech, of Moscow (Dingl. Journ. 1884, vol. 253, 175), that the said works, after three years' existence with a very modest production, had now entirely discontinued the manufacture of santonine, saying that they had been in full work ever since they have been established. The factory is fitted up in the best possible manner (the boilers being fired with the seed refuse), due regard being taken for enlargements, whereby the future production may be easily raised to three times that of the present (900kilos. per month), in case the demand for santonine should continue to increase.—F. M.

A Fourth Alkaloid in the Box-tree. G. A. Barbaglia. Berichte, 17, 2655.

A quantity of alkaloid substances may be extracted from the leaves and branches of the box-tree by the usual method, and these are then treated in the manner given for the separation of the three colouring matters: buxverdin, buxorubin, and buxoxanthin. These substances are dissolved in alcohol, and the liquid neutralised exactly, with an alcoholic solution of oxalic acid. The white precipitate formed is separated, boiled repeatedly with distilled water, dissolved in dilute aqueous oxalic acid, and finally shaken with ether after making alkaline with sodium carbonate. The ethereal solution, after filtering from buxinidin, is concentrated, and on cooling, a new alkaloid, to which the author has given the name of "parabuxinidine," crystallises out. This alkaloid forms thin transparent prisms, insoluble in water, soluble in alcohol. The author intends to complete his investigations on this body.—J. B. C.

Improvements in the Process of Manufacturing Iodoform, Bromoform, and Chloroform. Theodor Kempf. Eng. Pat. 8148, May 23, 1884.

This invention relates to the manufacture of the above substances by electrolysis from suitable halogen compounds of the alkalis and alkaline earths—in the presence of alcohol, aldehyde, acetone, and of heat. The solutions are electrolysed in an atmosphere of carbonic acid and with constant heating. To obtain iodoform in large crystals, iodide of potassium is dissolved in alcohol of 20% and electrolysed as stated. To obtain bromoform or chloroform, the electrolysis is similarly conducted, but without carbonic acid.—T.

XXI.—EXPLOSIVES, MATCHES, Etc.

Process for the Recovery of the Waste Acids from the Manufacture of Nitro-Glycerine. Dingl. Polyt. Journ. 255, 216, 1885.

According to W. Poltsch (Ger. Pat. 29,664, October 31, 1883), when these waste acids, consisting of sulphuric acid, nitric acid, and unknown organic nitro bodies, are heated to 105°, the nitro compounds are decomposed and oxidised, at the expense of the nitric acid, to carbonic acid. So much heat is evolved in this re-action that the still undecomposed nitric acid, along with the lower oxides of nitrogen, is driven off, and pure sulphuric is left. He employs a closed stone or lead vessel, three to four metres high by forty centimetres wide, provided with a false bottom. The upper space is filled with flints. A pipe opening just above the false bottom introduces hot air, whereby the flints become warm. The waste acids are allowed to enter the vessel at the top through a funnel, in thin streams, and passing over the heated flints are decomposed. The oxides of nitrogen, along with the introduced air, pass away by a tube through cooling pipes into a Woulff's bottle, where more air is added, whereby nitric acid is produced. The denitrated sulphuric acid flows through the false bottom, and is led away from the lower space by a leaden pipe. —W. M.

Improvements in the Preparation of Blasting-powder from Nitrated Cellulose. W. Gedge. A Communication from W. F. Wolff and Max von Förster. Eng. Pat. 13,522, October 13, 1884.

Thin plates of nitro-cellulose, prepared either by compressing the finely divided wet substance into sheets or by slicing blocks of the compressed material, are sawn into strips, the strips into grains; or the strips and grains may be stamped out of the plates. The grains may be "coated" by immersing them in a solvent of the nitro-cellulose, or in liquid paraffin with the object of rendering them less liable to crumble. It is stated that by so proceeding, a dense powder is obtained having an effect similar to that of compressed gun-cotton in large pieces.—W. D. B.

Experiments with Dynamite Cannon. Dingl. Polyt 254 [6], 248, 1884.

Recent experiments conducted at Fort Lafayette with the dynamite cannon briefly described in Journ. Soc. Chem. Ind. 1884, p. 532, have given favourable results. With a projectile weighing 19kilos., and not charged with dynamite, the deviation from the line of sight was 0·61m. (? range). When the projectile was loaded with charges of ordinary dynamite weighing from 6·8kilos. to 7·6kilos. the deviation in all cases was less than 0·914m. The explosion of the charges formed large craters, from which earth and stones were projected 30m. into the air. Pointing seaward, at an angle of 22°, and with an air pressure of 36 atmospheres, the range of a projectile weighing 10kilos. was 2000m. F. H. Snyder (Scientific American, 1884, 50, 295) adopts the arrangement here figured for projecting from an ordinary 12-pounder Rodmann gun with the usual charge of powder, a shell of dynamite in place of a ball. The premature explosion of the dynamite by the powder used for its propulsion is

sought to be prevented by means of buffers. B is the shell attached to the wooden rod A. In the foremost part of the shell the dynamite is placed, and between the rod and the explosive, the buffer D, consisting of a caoutchouc cylinder with numerous air spaces, E, closed with the tightly-fitting cap K, is provided. When the weapon is employed for naval purposes the wooden rod is of considerable length, and is shaped as shown at C, but when used on shore the rod is quite short and plain. Between the end of the rod and the charge of powder, the buffer arrangement T, S, W, X, L, F,

To avoid these difficulties, the author proposes to use hydrogen peroxide, which is added to an acetic acid solution. Under these circumstances, the whole of the iodine is separated from the iodide, while bromides and chlorides are unaffected.

Details of the methods of employing the test for qualitative and quantitative purposes are given; in the latter case, the iodine is extracted by means of chloroform, the solution is washed with a little water to remove hydrogen peroxide, and the titration of the iodine then effected in the usual manner.

Fig. 1

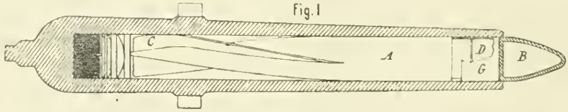


Fig. 2

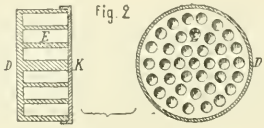
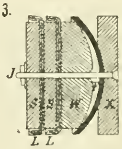


Fig. 3.



is placed; it serves as a wad, and also to prevent extreme violence of concussion being communicated to A. S, S, W are discs of wood, or paper pulp. F is a concave disc of copper, which acts as a spring. L, L, leather washers, to prevent escape of gas. In the experiments, a shell containing 2·27kilos. of dynamite was thrown 1200m. from a 12 pounder Rodmann gun, using a charge of sporting powder. The success of these trials has induced the authorities of the United States to direct more extended experiments at Sandy Hook.—W. D. B.

Mr. C. E. Groves and Dr. Stevenson both testify to the value of the nitrous acid method for determining small quantities of iodine in presence of much chlorine.

—W. S.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

On Toughened Filter-Paper. E. E. H. Francis. Proc. Chem. Soc. [3], 19.

FILTER-PAPER which has been immersed in nitric acid (sp. gr. 1·42) and washed with water is remarkably toughened, the product being pervious to liquids, and quite different from parchment-paper made with sulphuric acid. Such paper can be washed and rubbed without damage, like a piece of linen. The paper contracts in size under the treatment, and the ash is diminished; it undergoes a slight decrease in weight, and contains no nitrogen. Whereas a loop formed from a strip 25mm. wide of ordinary Swedish paper gave way when weighted with 100-150grm., a similar loop of toughened paper bore a weight of about 1·5kilo. The toughened paper can be used with the vacuum pump in ordinary funnels without extra support, and fits sufficiently closely to prevent undue access of air, which is not the case with parchment-paper. An admirable way of preparing filters for the pump is to dip only the apex of the folded paper into nitric acid and then wash with water; the weak part is thus effectually toughened.

—W. S.

The Detection and Estimation of Iodine. Ernest H. Cook, B.Sc. (Lond.). Proc. Chem. Soc. [3], 19, 20.

THE usual tests for iodine when existing as an iodide are rendered somewhat difficult by the circumstances that nitrous acid liberates bromine as well as iodine, while, if an excess of chlorine be employed, colourless chlorides of bromine and iodine are formed. These difficulties become of importance when it is desired to detect small quantities of iodides in the presence of comparatively large quantities of bromides, or when a quantitative estimation is to be made of the iodine.

A Quick Method for the Estimation of Phosphoric Acid in Fertilisers. J. S. Wells, Columbia College. Proc. Chem. Soc. [3], 20.

FINDING the ammonium molybdate method too long and tedious when many analyses of fertilisers had to be done, the author has adapted Joule's citric acid method as a gravimetric process. He employs two solutions: A, consisting of citric acid 900grm., ammonia solution (rel. den. 0·92) 1400cc., water 500cc.; and B, a strong solution of magnesium citrate. 1grm. of the fertiliser is fused with sodium carbonate and nitrate, dissolved in nitric acid, and the silica filtered off. To the filtrate some of solution A is added, and the whole allowed to stand for half an hour; enough of solution B is then added to precipitate the phosphoric acid. For the author's experiments, a test solution was made up of sodium phosphate, calcium chloride and ammonia-iron alum, so as to contain P_2O_5, 19·83 per cent., CaO, 25 per cent., Fe_2O_3, 3 per cent.; equal portions were taken for analysis, the comparison of his results with theory being given in a table. He compares his own method with the ammonium molybdate method on several fertilisers, with the following results:

	Ammonium citrate method.	Ammonium molybdate method.
1.	4·23 per cent.	4·23 per cent.
2.	18·36 ,,	18·18 ,,
3.	3·42 ,,	3·64 ,,
4.	14·01 ,,	13·92 ,,

Mr. F. J. Lloyd believes the accuracy of the results as above obtained would depend on, and vary with, the kind of material tested.—W. S.

The Estimation of Chromium. H. Peterson. Dingl. Polyt. Journ. 254 [6], 271, 1884.

ACCORDING to the author, the methods devised by Blair and Schöffel are not to be recommended. The following is considered better: The metal is finely pulverised and 0·5grm. is warmed with 35cc. of dilute sulphuric acid. The solution is treated with a slight excess of concentrated potassium permanganate solution to destroy any soluble hydrocarbons, the ferric sulphate is reduced with zinc, and, if care be taken to leave a trace of ferric salt, there is no fear of the chromium sulphate being reduced,—

the solution diluted with water to one litre and the iron titrated with standard permanganate. After titration the solution containing much sulphuric acid is heated to boiling, and permanganate solution, of which 1cc. corresponds to 0·01grm. of iron, run in slowly till much peroxide of manganese has separated; or, with greater safety, potassium permanganate is added till the permanent red colour of the solution proves it to be present in excess. The excess is reduced with manganous sulphate, and the solution which now contains the chromium in the form of chromic acid is filtered through a large filter, the residue being washed with hot water. The filtrate when quite cold is treated with a known excess of iron-ammonium sulphate, of which the amount remaining unoxidised by the chromic acid is determined by titration with standard permanganate.—W. D. B.

On the Valuation of Calcium Tartrate. Dingl. Polyt. Journ. 254 [12], 491.

According to L. Weigert (*Zeitschrift fur analytische Chemie*, 1884, S. 357), besides crude argol, also calcium tartrace now serves as raw material for the manufacture of tartaric acid compounds. In both cases the dealings are based on tartar-degrees—that is, the percentage of calcium tartrate contained is expressed in the equivalent quantity of potassium bitartrate. Thus 260 parts of crystallised calcium tartrate are equivalent to 188·11 parts of potassium bitartrate, or one tartar-degree is 188·11 : 260 = 1·3821kilos. calcium tartrate in 100kilos. of the crude substance, whilst 1 per cent of a kilogram of (pure) calcium tartrate = 0·7235 of a tartar-degree (Weinstein-Grad). In order to estimate its technical value the calcium tartrate is decomposed by boiling with potassium carbonate into neutral potassium tartrate and calcium carbonate. After filtering off the residue the solution is evaporated and mixed with acetic acid to bring about the formation of potassium bitartrate, and this is washed with alcohol and titrated. At the same time the excess of potassium carbonate which is used should be as small as possible, the acetic acid also added only in corresponding excess, the washing sufficiently long continued, and the mixture of potassium carbonate and tartrate, after treatment with acetic acid, must still contain some water on treatment with alcohol in order to obtain exact results. The analytical details are as follows :—5grm. of powdered calcium tartrate are placed in a small flask with 30cc. of a 10 per cent. solution of potassium carbonate, and heated for one or two hours in a water bath. The flask itself becomes strongly attacked, but this is without influence on the result. The contents are filtered into a porcelain basin, and washing with hot water is continued until the washings cease to react on red litmus paper. The filtrate is evaporated in the porcelain basin on the water bath to about 5cc. (not to dryness). 5cc. strong acetic acid are now added and moved about in the dish so as to come in contact with every portion of the residue, and the whole is placed on a water bath for one or two minutes, as the acetic acid does not react quickly enough in the cold. 100cc. of 90 per cent. alcohol are now added and allowed to stand several hours. Then it is filtered and washed with about 100cc. of 80 per cent. to 90 per cent. alcohol until 10cc. of the washings, after dilution with twice the volume of water, require only one or two drops of standard potash for neutralisation. Such a standard potash solution is used as serves for estimations of acidity in wines, and of which 1cc. corresponds to 0·01grm. tartaric acid or 0·02508grm. potassium bitartrate. To the quantity of tartar found by the titration 0·0165grm. tartar is added as correction for the above quantities of liquids used, or, if 5grm. calcium tartrate is used, 0·33 per cent. tartar must be added. These corrections allow for the quantity of tartar remaining in the solutions, and are the mean of many estimations. In testing calcium tartrate for carbonate a titration is admissible, not on account of the difficulty of decomposition or the want of sensitiveness of the indicator, but on account of a remarkable displacement of the neutral point, occasioned by the impurities present in the crude calcium tartrate, the error sometimes being as much as 10 per cent. calcium carbonate. The carbonic acid must therefore be evolved for estimation by weight or volume. Calcium tartrate is sometimes met with in commerce, which contains potassium bitartrate; this is especially the case, if, in the working up of the lees, too small a quantity of hydrochloric acid has been used. It is recognised that one part of hydrochloric acid (HC_2) is capable of dissolving 5·15 parts of potassium bitartrate, but this is only true for a boiling temperature. In the cold double that quantity is always necessary in order to keep the potassium salt in solution, otherwise a retrograde action takes place. If only so much hydrochloric acid has been added in the working up of the lees, as to keep the tartar dissolved whilst hot, some of the tartar separates out, part remaining in the cloths of the press, and part separating out when the solution is treated with the powdered chalk.—G. H. B.

Errata.—In February number of this Journal, on p. 107, col. 2, line 2 from top, after "thick," insert "tar." On p. 112, col. 1, lines 15 and 62 from top, and in col. 2, lines 11 and 15 from top, for "ısabonaphtha," read "ssabonaphtha." On same page, col. 1, lines 1 and 2 from foot, omit the word "however."

New Books.

A Practical Treatise on the Raw Materials and Fabrication of Glue, Gelatine, Gelatine Veneers and Foils, Isinglass, Cements, Pastes, Mucilages, etc., based upon actual experience. By F. Dawidowsky. Translated from the German, with extensive additions, including a description of the most recent American processes, by William T. Brannt. Illustrated by thirty-five engravings. Philadelphia: Henry Carey, Baird & Co., Industrial Publishers, Booksellers, and Importers, 810, Walnut Street. London: Sampson, Low, Marston, Searle, and Rivington, Crown Buildings, 188, Fleet Street; 1884.

This is an 8vo volume, bound in cloth, and containing 284 pages of subject-matter, a table of contents, and a copious index. It is also illustrated with thirty-five engravings. The subdivisions of the table of contents, forming also the chapter headings, are as follows: I. What is Glue? II. Raw Materials and Manner of Preparing them for the Manufacture of Glue; III. Fabrication of Glue; IV. Plan and Arrangement of a Glue Factory; V. Gelatine and its Preparation; VI. Uses of Glue and Gelatine; VII. Different Varieties of Glue and Gelatine, and special directions for their preparation; VIII. Cements and Pastes; IX. Pastes and Mucilages; X. Present Status of the Fabrication of Glue.

Alkali Tables for the Use of Chemical Merchants, Manufacturers and Brokers. By Oswin Bell. Newcastle-on-Tyne: Boazman, Dickson & Co., 25, Quayside; 1885.

A small pamphlet measuring about $3\frac{1}{2}$ by $2\frac{1}{4}$in., with paper cover; price 1s. The tables are arranged after the fashion of a ready reckoner, and are such as to enable one to see at once the value per ton from the value per unit per cwt., less various discounts.

The Gas Manager's Handbook, consisting of Tables, Rules, and useful information for Gas Engineers, Managers, and others engaged in the Manufacture and Distribution of Coal-gas. By Thomas Newbigging, Memb. Inst. of Civil Engineers. Fourth Edition. Illustrated. London: Walter King, 11, Bolt Court, Fleet Street; 1885.

Small 8vo volume, handsomely bound in morocco leather and gilt, containing 382 pages of subject-

matter, tables of contents, and illustrations, of which the work contains 280, and a copious alphabetical index. The work contains concise but adequate information and practical data on the following heads:—Coal and Cannel; Retort-house, Retort-benches, Retorts and Mountings; Condensation and Condensers; Exhausters; Steam Boiler and Engine; Washers; Scrubbers; Bye-pass Mains and Valves; The Tar Well; Purification and Purifiers; Tests for Detection of Impurities; Station Meter House and Meter; Pressure Gauges; Pressure and Exhaust Registers; Gasholder Tanks; Gasholders; Station Governor and District Governors; Main Pipes; Discharge of Gas, in cubic feet per hour, through pipes of various diameters and lengths, at different pressures; Service Pipes and Fittings; Public Lighting; Consumers' Gas Meters; Internal Fittings; Public Illuminations; Illuminating Power; Specific Gravity of Gas; The Use of Gas for Cooking, Heating, and Motive Power; The Residual Products; Coal Products; Chemical and other Memoranda; Sundry useful information relating to Gas Works, Gas Apparatus, Gas Manufacture and Supply; Miscellaneous; Office Memoranda; Epitome of Mensuration; Arithmetical and Algebraical Signs; Approximate Multipliers for facilitating Calculations; Table of Squares, Cubes, Square Roots, Cube Roots and Reciprocals of Numbers; Table of the Fourth and Fifth Powers of Numbers; Table of Diameters, Circumferences, and Areas of Circles, and Sides of Equal Squares; Weights and Measures, Decimal System.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

2620 C. P. Scrimshire, Blaenavon, Monmouthshire. A compound furnace. February 26

2642 J. H. Johnson, London. Improvements in filter presses. Communicated by F. Quarez and R. Quarez, France. Feb. 26

2862 J. Laidlaw, Glasgow. Improvements in centrifugal machines, otherwise known as hydro extractors. Complete specification. March 1

2964 J. Prince, London. Improvements in brick kilns, and in kilns for burning clay, china, earthenware, etc. March 6

3055 R. J. Friswell and A. Myall, London. Improvements in filter presses. March 9

3079 H. E. Newton. Improvements in materials for lining furnaces, cupolas, and similar apparatus. Communicated by J. E. Verdié, France. March 9

3133 J. Imray, London. An improved manufacture and application of materials for lining furnaces and metallurgical vessels or utensils. Communicated by H. Rémaury and F. Valton, France. March 10

3165 W. P. Thompson, Liverpool. Improvements in furnaces. Communicated by A. Backus, jun., United States. Complete specification. March 11

3267 P. Woodrow, Glasgow. A new or improved gas furnace for heating tubes. March 13

3280 M. Pass, London. A mill or apparatus for effecting at the same time the combined operations of drying and crushing or grinding, reducing, triturating, or amalgamating, applicable to the treatment of sulphate of lime, whiting, cement, guano, and other materials or substances. March 13

3361 A. G. Browning and F. G. Vivian, Llanelly. Improved retort settings. March 16

3418 R. M. McDougall, Glasgow. Insuring safety from collapse in stills or other close vessels. March 17

II.—FUEL, GAS, AND LIGHT.

2401 J. F. Braidwood, London. Improvements in means and apparatus for closing the mouths of gas retorts, applicable to other like purposes. February 21

2417 A new or improved torch and composition for same. Communicated by J. Dax, Germany. Complete specification. February 23

2489 G. Love, jun., London. Improvements in condensing apparatus for treating or purifying coal gas. February 24

2500 J. Barnett, London. Improvements in the use of artificial fuel. February 24

2533 J. A. Yeadon, Leeds. Improvements in the manufacture of coke. February 25

2681 D. J. Blaikley, London. An apparatus for detecting the presence of coal or other gas in atmospheric air. February 27

2720 W. S. Oliver, London. Improvements in the manufacture of gas for heating and illuminating purposes. Feb. 28

2856 E. Davies, Liverpool. Improvements in obtaining or collecting gas for illuminating or heating purposes. March 1

2891 W. Potter, London. An improved method of and apparatus for heating, enriching, and consuming coal gas. March 4

2918 J. O. Spong, London. Improved means and apparatus connected with the production of gas for use with liquid fire-extinguishing chemicals. March 5

3323 T. Alexander, S. Alexander, and R. Paterson, Glasgow. Improvements in apparatus for making oil gas. March 11

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

2693 F. J. Rowan, Glasgow. Improvements in distilling and obtaining useful products from coal or other carbonaceous mineral, and in apparatus therefor. February 28

3285 A. W. L. Reddie, London. Improvements in the doors of coke furnaces. Communicated by C. Dahlmann, Germany. March 13

IV.—COLOURING MATTERS AND DYES.

3149 H. J. Haddan, Westminster. A manufacture of blue and violet colouring matters. Communicated by the Farbenfabriken vormals F. Bayer & Co., Germany. March 10

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

2534 S. H. Sharp, Halifax. An improved means and method of making woven and felted fabrics, cardboard, and wood, waterproof and acidproof. February 25

2556 J. C. Mewburn. Improvements in drying textile fabrics or other materials. Communicated by Pierron and Dehaître, France. February 25

3096 W. Mather, London. Apparatus for soaking, boiling, or dyeing textile materials, or subjecting them to the action of liquids or gases. Complete specification. March 10

3170 J. Scott, Dover. Scott's process for dry cleaning textile fabrics. March 11

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

2580 T. Holliday, London. Improvements in the production of azo colours on textile fibre. February 25

3219 J. A. Ashwell, Liverpool. Improvements in the process of dyeing hosiery and other like goods, and in apparatus therefor. March 12

VII.—ACIDS, ALKALIS, AND SALTS.

2473 J. W. Kynaston, Liverpool. Improvements in the manufacture of sulphur from sulphuretted hydrogen. Feb. 21

2478 W. Weldon, Burstow. Improvements in obtaining solid caustic soda from fused caustic soda. Communicated by A. R. Pechiney et Cie., France. Complete specification. February 24

2578 H. Simon, London. Improvements in apparatus for the distillation of ammonia from ammoniacal liquors, and for the treatment of the resulting ammoniacal vapours. Communicated by the Berlin Anhaltische Maschinenbau-Actien Gesellschaft, Germany. February 25

2645 J. O. Spong, London. Improved means and apparatus connected with the production of carbonic acid gas for extinguishing fire. February 26

2761 W. Weldon, Burstow. Improvements in the manufacture of caustic strontia. March 2

2762 W. Weldon, Burstow. Improvements in and relating to the utilisation of the phosphoric acid of the slag of the basic steel process. Communicated by E. Lombard, France. March 2

3098 J. Wilson, Edinburgh. Improvements in decomposing liquors containing chloride of magnesium. March 10

3326 J. H. Wright, Liverpool. Improvements in the manufacture of chloride of ammonium. March 14

VIII.—GLASS, POTTERY, AND EARTHENWARE.

2339 E. M. Knight, Halifax. Improvements in blown glass bottles and in the moulds employed in the manufacture thereof. February 20

2340 E. M. Knight, Halifax. Improvements in blown glass taps and in moulds employed in the manufacture thereof. February 20

3445 G. J. Atkins, London. A new or improved process for the decoration and treatment of glass, porcelain, metal, and other surfaces. March 17

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

2742 R. E. Goolden, London. The manufacture of improved plastic compounds. February 28

2775 W. J. A. Donald, London. Improvements in the manufacture of refractory materials and bricks and other fire-resisting articles suitable for lining furnaces and converters and for other uses. March 2

2806 J. Cawley, London. An improved mineral amalgam or cement. March 3

2886 W. Millar and C. F. Nichols, London. Improvements in the means of accelerating the setting and hardening of cements. Complete specification. March 4

2927 W. Millar and C. F. Nichols, London. A new or improved fibrous, fireproof, and waterproof composition for constructive, decorative, and other purposes. Complete specification. March 5

3097 J. Rust and H. J. Rust, London. An improved vitreous material for paving purposes. March 10

3139 F. Schiffner, London. An improved furnace or kiln for the production of cement or lime and for similar purposes. March 10

3251 G. M. Hammer and E. G. Hammer, London. Black or coloured plaster, cement, etc., for forming improved writing surfaces on walls, etc., of schools and class-rooms. March 12

X.—METALLURGY, MINING, Etc.

2338 J. Gjers, London. Improvements in means or apparatus for the treatment of steel ingots. Complete specification. February 20

2419 J. Edwards, G. W. Hannam, and F. H. Lyell, London. Improvements in dressing tin ores, and apparatus therefor. February 23

2633 A. W. L. Reddie. An improvement in the process of obtaining castings in steel or other metal. Communicated by G. L. Robert, France. February 26

2656 T. Gilmour, Glasgow. Improvements in casting steel. February 27

2860 D. and L. Roberts, Stockton-on-Tees. Improvements in furnaces and hearths or fireplaces for the refining of iron and steel, and also for the production of these metals. March 4

2877 F. Ellerhausen, London. Improvements in the extraction of metallic lead from sulphurous lead ores called galena. Communicated by S. Traynor, Spain. March 4

2973 W. E. Gedge, London. A new and improved process of precipitating lead from sulphurous lead ores. Communicated by F. Ellerhausen, Spain. March 6

3075 H. A. Nye and J. Whalley, London. Improvements in the construction of apparatus for desilvering lead; applicable also for lifting and transporting cements and other pulverulent substances, as also pulpy materials. March 9

3088 W. E. A. Hartmann, Swansea. Improvements in the electro deposition of copper. March 10

3386 N. C. Cookson, Newcastle-on-Tyne. Improvements in smelting sulphide of antimony. March 16

3457 L. A. Groth, London. A new or improved method of manufacturing the chloride or double chloride with sodium or potassium of aluminium or glucinum (beryllium) in a dry state. Communicated by R. Gratzel, Germany. January 5. Previously included in No. 156

XI.—FATS, OILS, and SOAP MANUFACTURE.

2381 M. Ayrton, Halifax. Improvements in the production of white oil or grease from black oil or brown grease. February 21

2990 E. Green and E. Needham, Halifax. Improvements in the manufacture of washing and cleansing fluid. March 7

3101 F. V. Greene, London. An improved process for extracting oil and albuminoid matter from maize and other grain. Complete specification. March 10

3411 C. R. Huxley, London. Ammoniated soaps, free from oleates, and compounded to dispense with the destructive friction of the brush. March 17

3419 F. O. Kloninger, London. Improvements in machinery for crushing and preparing fat for the refining operation. March 17

XII.—PAINTS, VARNISHES, and RESINS.

2754 J. W. Davies, London. Carbon black converting the refuse from prussiate of potash, alum, and other chemicals into black pigment, applicable for paint, japan, blacking, harness composition, india-rubber goods, engine packing, filters, and other purposes. March 2

3235 R. Uhlich and O. Muller, London. An improved anti-fouling composition. March 12

3412 W. Gibson, G. Wilson, and W. J. Clark, Great Driffield, Yorkshire. An improved composition for the prevention of corrosion or incrustation in steam boilers. March 16

XIII.—TANNING, LEATHER, GLUE, and SIZE.

2354 A. Anderson, Paris. An improved substitute fo leather. February 21

2735 R. R. Gubbins, New Cross, and C. K. Farquharson, London. Improvements in manufacturing and water-proofing artificial leather. February 28

3108 L. Simpson and J. Davis, London. Improvements in tanning apparatus. Complete specification. March 10

3213 M. Kitchin, London. Improvements in the means or apparatus for dissolving materials used in tanning. March 12

XV.—SUGAR, STARCH, GUM, Etc.

2329 J. Laidlaw, Glasgow. Improvements in the manufacture of sugar and in apparatus therefor. February 20

2553 H. J. Chapin, London. Improvements in apparatus or devices for the treatment of sugar-cane. Complete specification. February 25

2721 C. D. Abel, London. Process for the purification and decoloration of saccharine liquors, juices, or syrups. Communicated by La Société Nouvelle de Reffineries de Sucre de St. Louis, France. February 28

3050 W. P. Kelly, Graique, Ireland. Improvements in the manufacture of starch from rice. March 9

3208 J. F. Gent, London. Products prepared from rice. Complete specification. March 11

XVI.—BREWING, WINES, SPIRITS, Etc.

2402 J. R. Sharpe, London. An improved aerated beverage, to be hereafter known as "Sarine," and the method of preparing the same. Complete specification. February 21

2748 J. Death, jun., Cheshunt. Improvements in preparing and drying grain and gelatinised grain for use in brewing, and apparatus in connection therewith. March 2

3193 A. Behr, London. Apparatus and process for producing malt. Complete specification. March 11

3557 J. Imray, London. Manufacture of pressed yeast Communicated by M. Hatschek, Switzerland, March 19

XVII.—FOOD PRESERVING, MEATS, Etc.

2403 W. G. Gard, London. Improvements in preserving or curing flesh and fish. February 21

3554 C. Jeffs, Great Grimsby. Preserving fish in a fresh condition. March 19

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, Etc.

2352 J. G. Lorrain, London. Improvements in the filtration and purification of fluids, and in the oxidation of matters suspended or dissolved therein. February 21

2728 C. Price and H. Cleave, London. Improvements in the filtration of sewage, and in apparatus therefor. February 28

2739 J. C. Stevenson, London. Improvements in disinfectants. February 28

2865 G. H. Lloyd, London, Improved means and apparatus for producing transparent ice. March 4

2885 W. F. B. M. Mainwaring and J. Edmunds, London. Improvements in the treatment and purification of sewage and water containing organic matter. March 4

3172 W. D. Curzon and G. S. Jones, London. Improvements in the treatment and utilisation of sewage sludge. March 11

XIX.—PAPER, PASTEBOARD, Etc.

2722 C. D. Abel, London. An improved manufacture of safety paper for cheques and similar purposes. Communicated by the Patent Papier Fabrik zu Penig, Germany. February 28

2723 C. D. Abel, London. An improved manufacture of safety paper for cheques and similar purposes. Communicated by the Patent Papier Fabrik zu Penig, Germany. February 28

3009 W. H. Richardson and W. Bertram, Glasgow. Improvements in the manufacture of paper pulp, and in the apparatus or mechanism used therefor. March 7

XXI.—EXPLOSIVES, MATCHES, Etc.

2991 C. Dixon, Birmingham. Improvements in charges and cartridges to be used with certain kinds of powder for small arms and for other purposes. March 7

3152 C. E. G. Simons, Merthyr Tydvil. Non-inflammable explosives. March 11

*ENGLISH PATENTS PUBLISHED.**

APPLIED FOR DURING 1884.

I.—GENERAL PLANT, APPARATUS, and MACHINERY.

3252 (1873, Reprint) E. Voisin. Cupola furnaces. 6d

5188 H. Wedekind. Kilns for burning bricks or other analogous articles. Communicated by H. Dueberg. 6d

6342 J. Woods. Heating kilns, muffles, ovens, etc., and bricks, slabs, or blocks to be used therein. 10d

6513 J. H. Johnson. Furnaces for burning liquid hydrocarbons. Communicated by J. Buffet. 6d

*Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	....	½d.
Above 8d., and not exceeding 1s. 6d.	....	1d.
,, 1s. 6d., ,, ,, 2s. 4d.	....	1½d
,, 2s. 4d., ,, ,, 3s. 4d.	....	2d.

6765 J. G. Wilson. Improvements in crucibles and other vessels for melting, refining, or converting metals, and means for heating same. Communicated by J. E. Bott. 6d
7236 G. King. Fastenings for retort lids. 6d
7374 T. Knott. Furnaces. 6d

II.—FUEL, GAS, AND LIGHT.

3766 H. H. Hazard. Condensation and absorption of the products of combustion from coal or other gas or oil used either for lighting or heating purposes. 6d
5932 R. Irvine. Improvement in the distillation of coal in the manufacture of coal gas for the subsequent purification of the said gas. 2d
6094 W. Young and G. T. Beilby. Distillation of mineral oils, and apparatus therefor. 1s. 2d
6555 A. C. Henderson. Method and apparatus for manufacturing carburetted hydrogen gas for lighting or heating. Communicated by C. Wilhelm. 6d
6631 M. Schwab. Apparatus for making illuminating gas. Communicated by J. Overhoff. 6d
6983 A. P. Price. Purification of coal gas, or other gases containing ammonia or ammoniacal compounds. 4d
8409 W. Young and G. T. Beilby. Distillation of mineral oils, etc. 10d
8879 J. E. Walsh. Furnaces and retorts for the manufacture of gas. Communicated by A. Ryex. Amended specification. 8d
13580 H. H. Lake. Extraction of paraffin or other solid substance from oil or other liquid, and apparatus therefor. Communicated by R. H. Smith, United States. 6d
14198 H. G. Fairburn. Machinery for washing, separating, and purifying coal and other substances. 4d

IV.—COLOURING MATTERS AND DYES.

5512 J. H. Johnson. Preparation of yellow colouring matters from tetramethyldiamidobenzophenone and analogous ketone bases or their halogen derivatives. Communicated by the Badische Anilin und Soda Fabrik. 4d
7097 J. Wetter. Producing betanaphthol-disulpho-acids, separating the same, and obtaining colouring matters therefrom. Communicated by the Leipziger Anilin-fabrik, Beyer and Kegel. 4d
7098 J. Wetter. Separating the different betanaphthol-monosulpho acids from a mixture of the same, and obtaining colouring matters therefrom. Communicated by Beyer and Kegel. 4d
15156 W. E. Gedge. Method of preparing alizarin and other anthracene colouring substances. Communicated by G. Jagenburg and C. Leverkus & Sons. 2d

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

11231 J. P. Delahunty. Dyeing garments, etc. 6d

1885.

471 W. Mather. A process for bleaching webbs or yarns of vegetable textile materials. 2d
687 G. Kassner. Improvements in the process of bleaching. 2d

VII.—ACIDS, ALKALIS, AND SALTS.

3723 W. L. Wise. Manufacture of salicylic acids. Communicated by Chemische Fabrik, vormals Hofmann und Schoetensck, Germany. 2d
5975 J. Wilson. Manufacture of chlorate of potash. 4d
6022 E. F. Trachsel. Producing oxide and carbonate of strontium, of barium, or of calcium, and obtaining by-products therefrom. 4d
6051 W. V. Wilson and J. Storey. Production of compounds containing nitro-cellulose. 4d
6179 J. Mangnall and R. S. Lloyd. Generating carbonic acid gas, and apparatus therefor. 6d
6215 W. P. Thompson. Purifying sulphuric acid, and recovering the arsenic and antimony therefrom. Communicated by G. Thomson and W. Kemp. 4d
6290 G. Rosenthal. Manufacture of alumina and potash alum. 4d
6367 S. Gilchrist Thomas. Manufacture of sodium. 2d
6461 W. V. Wilson. Manufacture of lead salts, for application to the manufacture of white lead. 6d
6731 W. J. A. Donald. Manufacture of chromates and bichromates. 2d

VIII.—GLASS, POTTERY, AND EARTHENWARE.

6899 J. H. Johnson. Manufacture of white opaque glass, and enamel. Communicated by — Tedesco. 4d
17045 W. R. Lake. An improved compound to be used as a substitute for ivory. Communicated by J. B. Edson, United States. 4d

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

6157 F. Ransome. Manufacture of cement. 4d
7395 J. A. Jones. Concrete or artificial stone for paving or other purposes. 2d
7397 J. A. Jones. Concrete or artificial stone for paving or other purposes. 2d

X.—METALLURGY, MINING, ETC.

5245 T. Slater. Manufacture of alloys of chromium, and utilisation thereof in the coating of metallic surfaces. 4d
6371 D. G. Fitzgerald. Refining gold and silver. 4d
6433 H. H. Lake. Compound metal or alloy for deoxidising and coating metal plates. Communicated by J. Benbow Jones. 4d
6722 A. P. Price. Obtaining copper. 2d
7237 J. Beasley. Manufacture of iron and furnace linings to be used in said manufacture. 4d
7940 A. M. Clark. Process of treating iron. Communicated by R. B. Abbott. 4d
11690 F. J. Brougham. Process of and means for equalising the temperature in cast-steel ingots. Communicated by A. Sailler. 6d

XI.—FATS, OILS, AND SOAP MANUFACTURE.

6271 E. Sonstadt. Manufacture of soaps, dentifrices, and other detergent substances. 2d
6786 W. P. Thompson. Bleaching or purifying dark-coloured mineral and other distillable oils. 6d
11681 C. R. A. Wright. Improvements in the manufacture of soap. 4d

XII.—PAINTS, VARNISHES, AND RESINS.

2630 A. Germot and L. Riviere. Treating certain resins for obtaining a new elastic substance. 4d
5192 J. C. Martin. Manufacture of red pigments or paints. 2d
6936 E. Metcalf. Preserving and preventing incrustation in steam boilers. "The new anti-corrosive preparation." 2d

1885.

39 S. R. Hooper. Improvements in the manufacture of euphorbia paints. 2d

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

3375 J. Salamon. Process of tanning hides or skins. Communicated by L. Vergez. 4d

XV.—SUGAR, STARCH, GUM, ETC.

7199 J. Jeyes. Manufacture of elastic compounds. 4d
7235 V. Daix and A. L. Passoz. Extraction of sugar from molasses and other saccharine products. 4d
15150 J. J. C. Smith. Manufacture of rubber compositions. 4d
17092 G. W. Parbury. Process and apparatus for treating megass for extracting sugar therefrom. Communicated by G. Kottmann. 4d

XVI.—BREWING, WINES, SPIRITS, ETC.

4945 J. McFarlane. Stirring apparatus for mash tuns, etc. 6d
5096 F. S. Barff. Treatment of liquids and substances which are subject to fermentation. 2d
5747 W. Aubert. Preserving Lager beer. 4d
6310 J. A. Meylers. Treatment of locust beans for the purpose of preparing beverages therefrom. 2d
6557 G. Epstein. Treatment of grain or other materials for the production of alcohol therefrom. 6d

1885.

16 P. Platt and J. M. Aitchison. Kilns for drying malt, hops, etc. 4d

XVII.—FOOD PRESERVING, MEATS, ETC.

6304 E. Sonstadt. Preparation of salt, saltpetre, sugar, and other antiseptic substances for use in the preservation of food. 2d
16700 M. Bauer. Improvements in the manufacture of meat powder. 2d
16704 M. Bauer. The manufacture of preserved meat and vegetables. 2d

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, ETC.

3125 (1876, Reprint) A. Fryer. Treating refuse, etc. 6d
5496 (1883, Amended) W. Anderson. Purification of water. 6d
6114 W. P. Thompson. Utilization of human excreta, etc. Communicated by — Bryden. 10d
7255 M. Williams. Preparing lime for sanitary purposes. 2d
13282 A. T. Smith. A material in a granulated form for the purpose of filtering sewage and other fluid matter. 2d
17084 A. J. Marquand, E. Hancock, and J. R. Powell. Prevention of corrosion and removing of deposit in steam or other boilers. 4d

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

6904 N. A. Helouis. Manufacturing light essences by the distillation of coal, wood, turf, oil, and other similar substances. 8d

XXI.—EXPLOSIVES, MATCHES, ETC.

7299 E. de Pass. Railway detonating signals, etc. Communicated by Lirand and Gaupillat. 6d

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THE JOURNAL

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A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Edmund K. Muspratt has been nominated to the office of President, and Dr. W. H. Perkin, F.R.S., has been nominated Vice-President under Rule 11.

Mr. I. Lowthian Bell, F.R.S., Dr. Peter Griess, F.R.S., Mr. John Spiller, and Mr. E. C. C. Stanford have been nominated Vice-Presidents under the provisions of Rule 8; and Sir Bernhard Samuelson, Bart., M.P., and Dr. S. A. Sadler have been nominated ordinary members of Council in the place of Dr. Peter Griess, F.R.S., and Mr. John Spiller, nominated Vice-Presidents under the provisions of Rule 17.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill the four vacancies thus created among the ordinary members of Council, in accordance with the provisions of Rule 18. Nomination forms for this purpose can be obtained from the General Secretary upon application.

Members are hereby informed that the Annual General Meeting (1885) will take place in London in the second week in July. Details and arrangements will be published in due course, and members will receive their tickets of membership, which, as heretofore, will form vouchers in visiting works and places of interest.

Authors of papers printed in the Journal are hereby notified of the fact that, in accordance with Bye-law 43, they are entitled to receive not more than 50 gratuitous copies of their papers. Authors should state on their manuscripts their desire to have free copies, adding the number wished for. Unless the contrary be specially desired, this being stated on the manuscript, the reprints of an author's paper will not include the report of any discussion that may have arisen after the reading of the paper.

Members are hereby advised that the Subscription for 1885 falls due at the beginning of the year, and should be paid as soon afterwards as possible. The Council has decided that after January 1st, 1885, the 29th Bye-law will be strictly enforced, so that Members whose subscriptions are more than four months in arrear, will not continue to receive the Society's Journal.

Inquiries having been made as to the transactions of the Newcastle Chemical Society, the Committee of the Newcastle Section have to state that a very few complete sets are remaining, and will be sold to members at £2 10s. per set. A number of separate volumes can also be had by members wishing to complete their sets, at 10s. per volume (generally three years' issue). Application for these should be made to the Local Secretary of the Newcastle Section.

LIST OF MEMBERS ELECTED APRIL 23rd, 1885.

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Thos. Coomber, 9, Osborne Road, Clifton, Bristol, chemical manufacturer.
John Craw, Caledonia House, Paisley, N.B., drysalter.
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M. W. Dunscombe, St. Augustine's Parade, Bristol, manufacturing optician.
H. M. Freear, 40, Osborne Road, Tollington Park, N., analyst.
Jas. M. Glen, Fereneze Printworks, Barrhead, N.B., calico printer.
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W. Arthur Jones, Kenwith Lodge, Redland, Bristol, soap manufacturer.
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Oscar Lowman, Polytechnikum, Charlottenburg, Berlin, student.
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C. W. Cope Proctor, Heathercliffe, Clifton Down, Bristol, agricultural chemist.
L. Trant O'Shea, Firth College, Sheffield, assistant lecturer on chemistry.
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MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

May 4.—Messrs. Giles and Shearer—"The Real Strength of Aqueous Solutions of Sulphurous Acid."
Messrs. C. Napier, Hake, and Mook—"The Stassfurt Salts Industry, and its bearing on other Industries."
Discussion on Professor Munro's paper published in January number of the Journal, "On the Manurial Value of Filter-Pressed Sewage Sludge," read January 5.
June 1.—Messrs. Salamon and W. de Vere Mathew—"The Influence of Phosphates upon Fermenting Worts." Mr. H. B. Yardley—"Additional Note on Alumina in Superphosphate."
July.—The Annual General Meeting.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held April 13, 1885.

FURTHER NOTES ON THE RADIAL PHOTOMETER AND THE PROPOSED STANDARDS OF LIGHT.

BY W. J. DIBDIN, F.I.C., F.C.S.

Chemist, and Superintending Gas Examiner to the Metropolitan Board of Works.

ONE of the first points which it is desirable to make clear, with regard to the use of the Radial Photometer

is the certainty attending the use of the instrument when the disc is arranged for equal angles of incidence of the rays from the standard and the light under examination. For the purpose of determining this question, I have made tests of the horizontal rays, with the disc in various positions—viz., vertical and inclined 22° and 45° in either direction, with the result that the readings obtained were perfectly concordant. It may, therefore, be assumed that the tests of rays, at angles above and below the horizontal, are correct when the screen is adjusted as I have directed. It is necessary that care should be taken to avoid errors due to reflection.

In the paper which I had the honour to submit to the Society last year, I drew attention to the difference in the quantity of light emitted from the broad part of flat flames, and from their edges. This question has since engaged my attention. I have made determinations of the quantity of light afforded in all directions horizontally by three classes of flames, testing them at every 10°. The results are stated in Table I. The diagrams show at a glance the positions in which the maximum light is thrown.

The value of the radial photometer is most strikingly shown in the examination of burners shaded by globes, reflectors, etc. For this purpose I have tested three Argand burners, fitted with different forms of shades. Table III. contains the results, which I have also put in diagram form. Two of these sets of observations clearly indicate that the form of the porcelain cup might be arranged to yield more satisfactory results, but considering the want of a suitable method of testing, before the radial photometer was introduced, there is little room for complaint. The effect of the well-known glazed-paper shade is very striking, the even distribution of light downward being very satisfactory. The tests of a Christiania burner, with and without its globe, are also interesting; but, as in this case the globe has to do the double duty of regulating the draught and reflecting the rays in a downward direction, it is difficult to see how its form can be improved. The tests of a new form of reflector well illustrate the character of the work of which the radial is capable. The tests may be taken at every degree where necessary, and thus most valuable comparative results obtained.

These instances might be multiplied almost indefinitely, but I do not think that more are required to point out the extensive range of work which this photometer renders possible. Further practice has shown that tests are easily and rapidly made, and that it is equally applicable for all classes of photometrical experiments.

The effect of a suitable reflector in diffusing the power of the light in particular directions is very marked, so much so, that in future competitive tests of burners and apparatus relating thereto, it would be highly desirable to make special awards for the best form and diffusing power of reflectors. In my judgment the most perfect reflector should throw the rays of light in such a manner as to evenly illuminate a level surface comprised within a circle whose circumference includes those rays falling at an angle of 30° below the horizontal.

The nearest approximation to this definition is the result given by the well-known porcelain shade supplied with Argand burners. When the cup is in position the rays, falling at all angles from 0° to 60° below the horizontal, are intercepted to an excessive extent. The importance of facility in testing a new disc for photometric readings is generally acknowledged. The form of carrier used with the radial photometer is especially adapted for readily adjusting the disc, so that either side may be turned towards the standard light. It is only necessary to loosen the screw holding the carrier when the latter can be rotated on its axis. I propose to use this form of disc carrier, which reverses the mirrors as well as the disc, in the photometers at the gas-testing stations of the Metropolis under my charge, and have obtained the sanction of the Gas Referees to the change, which, I feel certain, will be a decided advantage.

The Proposed Standards of Light.

Amongst the numerous proposals for obtaining a light of constant illuminating power, the most varied substances are to be found; in fact, hardly a combustible material seems to be omitted from the list. It is unnecessary to recapitulate them further than to call attention to those which have been found, after repeated and lengthy trials, to afford ground for the hope that amongst them may be one which will eventually prove to be reliable under all circumstances. These are six in number—viz., candles; Carcel and Keates' lamps; Harcourt's pentane or air-gas flame; Methven's screened Argand flame; and Sugg's "Ten-candle Test." The combustibles employed with these are sperm, sperm and colza oils, pentane, and coal-gas both with and without pentane.

I need hardly mention that the only legal standard in this country is the sperm candle of six to the pound, each consuming 120 grains of sperm per hour, and that the Carcel is the legal standard in France. This lamp should consume 42grm. of colza oil per hour, at which rate it yields an average light equal to 9·5 average English candles. I have obtained this figure from the results of tests made in 1870, by Mr. Sugg, when he found it to be equal to 9·6 candles, and the mean of several series of tests which I have recently made, when I compared it with both Mr. Harcourt's pentane flame, and the Keates lamp, the average result being that the Carcel lamp was equal to 9·41 candles. If it is assumed, therefore, to be equal to 9·5 candles, it is certain that that assumption will not be far from the truth.

The attention which has been paid to the important subject of the standard of light during the past few years has resulted in three separate investigations being made. The first of these was in 1880 and 1881, when the Board of Trade appointed a committee, consisting of Drs. Williamson and Odling, and Mr. G. Livesey, to examine "the Standards at present in use for estimating the Illuminating Power of Coal-Gas, and of the Standards which have been proposed by Mr. A. G. Vernon Harcourt, Mr. T. W. Keates, and Mr. J. Methven." The report of this committee was very unfavourable to candles, Keates' lamp, and Methven's screen, but decidedly in favour of Mr. Harcourt's air-gas flame.

In 1883, the Gas Institute appointed a committee to examine the candles, Mr. Harcourt's air-gas flame, Mr. Methven's screen, and M. Giroud's "Verificateur," and "Relative" standard. This committee engaged the services of Messrs. Heisch and Hartley to conduct the experiments, and these gentlemen reported strongly in favour of the Methven screen, and as strongly against the Harcourt air-gas. During the past winter I have had an opportunity of making further examinations of the various proposed standards, and have submitted the results obtained, up to the present, to a committee of the Metropolitan Board of Works in the form of a report. I have not yet furnished my investigations, and hope to extend the number of tests and manner of making them very considerably. So far as my work has gone, I am of opinion that the public has now before it several propositions of a most promising character. I have found

TABLE I.

Flat Flame Burners. Illuminating Power of Horizontal Rays.

Position of Flame.		Burner No. 1 Candles.	Burner No. 2 Candles.	Burner No. 3 Candles.
Flat to Photometer Bar		30·8	24·2	8·5
Flame Turned	10°	30·8	24·2	8·5
,, ,,	20	30·9	24·3	8·5
,, ,,	30	30·9	24·2	8·5
,, ,,	40	30·8	24·0	8·4
,, ,,	50	30·2	24·0	8·3
,, ,,	60	30·1	23·8	8·2
,, ,,	70	30·2	23·5	8·2
,, ,,	80	29·8	22·4	8·2
Edge to Bar ,, ,,	90	24·4	20·3	7·9
,, ,,	100	28·7	21·6	8·2
,, ,,	110	29·6	22·8	8·3
,, ,,	120	30·3	23·5	8·3
,, ,,	130	30·5	23·4	8·3
,, ,,	140	30·5	23·2	8·3
,, ,,	150	30·5	23·4	8·4
,, ,,	160	30·1	23·5	8·4
,, ,,	170	30·4	23·2	8·3
Flat to Bar ,, ,,	180	30·3	23·1	8·4
,, ,,	190	30·4	22·8	8·4
,, ,,	200	30·8	23·0	8·4
,, ,,	210	30·8	22·7	8·4
,, ,,	220	30·7	22·9	8·3
,, ,,	230	31·0	22·9	8·3
,, ,,	240	30·6	22·8	8·3
,, ,,	250	30·1	22·0	8·2
,, ,,	260	29·5	21·2	8·1
Edge to Bar ,, ,,	270	25·0	18·6	7·8
,, ,,	280	28·5	20·6	7·8
,, ,,	290	29·5	21·9	8·1
,, ,,	300	29·7	22·2	8·3
,, ,,	310	29·8	23·0	8·3
,, ,,	320	30·3	23·0	8·4
,, ,,	330	30·3	23·5	8·3
,, ,,	340	30·5	23·4	8·4
,, ,,	350	30·7	23·5	8·4
Flat to Bar ,, ,,	360	30·9	23·4	8·5

TABLE II.

Flat Flame Burners. Illuminating Power of "Angular" Rays.

Direction of Rays.	Burner No. 1 Candles.	Burner No. 2 Candles.
90° above horizontal	27·8	8·9
80 ,, ,,	29·2	9·0
70 ,, ,,	29·0	9·3
60 ,, ,,	30·5	9·3
50 ,, ,,	30·8	9·2
40 ,, ,,	30·9	8·7
30 ,, ,,	30·3	9·4
20 ,, ,,	30·4	9·3
10 ,, ,,	29·4	9·3
Horizontal	29·8	9·7
10° below horizontal	29·9	9·9
20 ,, ,,	30·2	10·0
30 ,, ,,	30·2	10·1
40 ,, ,,	29·8	10·0
50 ,, ,,	29·8	10·0
60 ,, ,,	30·0	10·7
70 ,, ,,	29·2	10·3
80 ,, ,,	28·7	11·2
90 ,, ,,	19·6	5·8

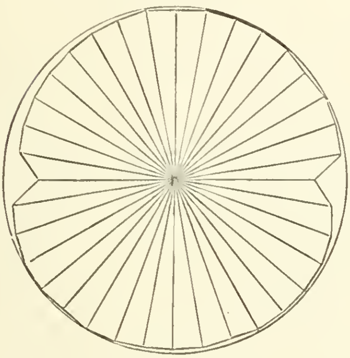
that Mr. Harcourt's air-gas standard is very satisfactory in its results, and is easy to work. In this matter I regret to find that I am in direct opposition to the strongly-expressed opinions of the two eminent photometrists who reported to the Gas Institute committee so unfavourably of the pentane. I also found that the Keates lamp is thoroughly reliable, and of a most satisfactory character in every respect. The Methven screen gave very contradictory results, but I am willing to believe that these were in some degree probably due to two things: 1st, the too hurried use of the burner after lighting; and, 2nd, variations in the height of the flame. I found this latter to be a most important point when the carburetted gas was used, in place of the plain coal-gas. I confess to being disappointed with the Methven arrangement. I expected variations of a kind, but I was not prepared for some of the extraordinary results which were obtained. I am anxious not to do Mr. Methven an injustice, and am content, especially after the strongly expressed opinions of Messrs. Heisch and Hartley, to await the results of further tests, and in the meantime distrust myself, before finally rejecting a proposal which has met with such strong support. I have made some careful tests of a new form of standard introduced by Messrs. Sugg & Co., and called by them the "Ten-candle Test." As submitted it was arranged to burn common coal-gas of various qualities. The inventors do not claim that the light emitted is of constant quality when gases of various illuminating power are used; but, on the contrary, furnish a table of corrections for the particular gas employed. The limited number of tests which I have made with the arrangement has not impressed me favourably with the idea of using ordinary coal-gas as a standard combustible in this case more than with the Methven. I therefore tried the expedient of burning coal-gas enriched with the vapour of pentane. To my surprise I found that the quantity of light emitted by the system, when this rich gas was used, remained precisely the same as when the uncarburetted gas was employed—viz., 10 candles. This result was due to the fact that when the rich gas was employed, a greater portion of "blue" flame is obtained, which compensates for the increased quantity of light emitted by the portion of the flame utilised. This fact affords an explanation of the decrease in the quantity of light emitted through the Methven slot when the flame produced by carburetted gas is too high. The lower portion of the flame is brought nearer to the slot, which is thus opposed to a light of diminished intensity. So far as my tests have extended, I find that the "Ten-candle Test," when burning enriched gas, is remarkably constant, and well merits further trial.

Summing up the general results of the tests which I have lately made, and expressing them, for convenience, in percentage variation from the mean, I find that the variations in the proposed standards were as follows—viz.:

FLAT FLAME BURNER No. 1.

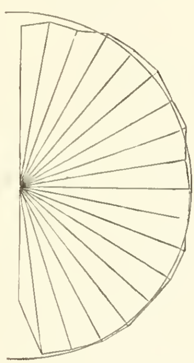
HORIZONTAL RAYS.
FLAT TO BAR.

EDGE TO BAR.



EDGE TO BAR.

ANGULAR RAYS.



PERCENTAGE OF TESTS WITHIN ONE PER CENT. OF THE MEAN.

CANDLES. Tests by different operators	13·7
CARCEL LAMP. Tests with two lamps	39·0
KEATES' LAMP. Tests made with various lamps, oils, and wicks	71·0
Tests with one lamp, for constancy, Series No. 1	68·4
Tests with one lamp, for constancy, Series No. 2	87·5
Tests by different operators	58·0
HARCOURT'S PENTANE. Tests of various samples of air-gas	94·0
Tests made by repeated adjustment of height of flame	100·0
Tests by different operators	41·0
METHVEN'S SCREEN. Tests made with "plain" and "carburetted" gas	37·0
Tests by different operators	12·5
SUGGS' "TEN-CANDLE TEST." Tests with "plain" and "carburetted" 16·7 candle-gas, and 14·2 candle-gas carburetted (eight tests only)	100·0

The objections to the above standards may be summarised thus:—

Candles.—Variability of composition and melting point of sperm, and of the number and size of threads.

Carcel Lamp.—Quality of oil employed. Uncertainty of height of wick and glass, and of composition of wick.

Keates' Lamp.—Time required to produce flame, and uncertainty attending the use of a wick.

Pentane.—Attention and skill required; sluggish and unstable character of flame; effect of vibration of room; difficulty of reading.

Methven's Screen.—Quality of gas used with "plain gas" screen. Uncertainty of height of flame, especially when carburetted gas is employed.

Suggs' Ten-candle Test.—Quality of "plain" gas used.

The replies to these objections are :—

Candles. None.
Carcel Lamp.—Admitted.
Keates' Lamp.—The time is about thirty minutes, or little more than that required with any other of the proposed standards. With this lamp there is no uncertainty as regards the wick.
Harcourt's Pentane.—When the apparatus is properly arranged the attention required is so little as to be of no moment. The flame is perfectly steady in the absence of draught, or excessive movement of disc carrier. Accidental vibration of room does not affect it, and that the difficulty of reading the photometer disc is overcome by practice.

the possibility of an opponent having good grounds for his assertions, or that the difficulties of the case are so great as to preclude one person using more than one system to the best advantage. The fact is that photometry is by no means a "two-foot rule" science. Nothing can exercise the patience of an operator more than prolonged observations of this character. Unremitting care and minute attention to numerous details are absolutely necessary for the attainment of accurate results. It is therefore not difficult to imagine that an operator intimately acquainted with all the peculiarities of a given standard should be liable to obtain more constant results with that than with another with which he may be less accustomed. The constant transition from one standard to another, each differing in every

Table III.

Effect of Reflectors and Shades.

Direction of Rays.	Argand No. 1.			Argand No. 2.			Argand No. 3.		Christiania.		Union.	
	Without Shade, etc.	With Reflector only.	With Reflector and Cup.	Without Shade, etc.	With Reflector only.	With Reflector and Cup.	Without Shade, etc.	With Paper Reflector.	Without Globe.	With Globe.	Without Reflector.	With Compound Reflector.
90° above horizontal	16·8	27·6	33·0	19·0	25·0	29·0	10·6	9·3	...	17·6	...	...
80 ,, ,, ...	20·0	30·8	36·6	21·0	29·0	33·0	14·0	13·7	14·0	18·4	...	...
70 ,, ,, ...	17·4	24·4	31·2	19·4	21·4	28·4	11·2	12·9	14·1	19·3	8·7	9·2
60 ,, ,, ...	18·2	14·8	21·0	18·8	13·8	19·2	15·0	11·0	13·4	10·3	8·7	9·2
50 ,, ,, ...	18·6	11·2	14·8	18·8	10·0	14·0	15·0	4·0	13·6	8·4	8·7	9·8
40 ,, ,, ...	18·8	9·8	12·8	18·4	8·4	11·0	15·1	1·3	12·8	8·0	8·6	10·4
30 ,, ,, ...	18·6	9·0	11·8	17·0	7·8	9·2	15·1	1·3	13·0	7·0	8·7	12·6
20 ,, ,, ...	18.6	7·6	10·1	17·2	6·4	8·4	15·0	2·0	12·4	6·5	8·8	19·6
10 ,, ,, ...	18·6	6·2	8·8	16·8	5·4	7·2	15·0	1·0	12·3	6·7	7·2	50·0
Horizontal....................	18·6	5·2	8·6	16·8	4·8	7·6	15·0	...	12·2	7·0	6·6	28·0
10° below horizontal	18·8	14·4	13·8	17·2	16·0	15·0	15·6	2·0	12·3	7·6	...	12·2
20 ,, ,, ...	19·2	24·2	15·6	17·8	21·6	14·2	15·8	12·5	13·0	7·6	...	...
30 ,, ,, ...	18·2	25·6	12·2	17·2	23·0	12·0	15·6	25·4	12·7	8·0	...	...
40 ,, ,, ...	16·4	26·0	11·8	16·8	23·4	13·4	14·0	31·0	12·8	9·0	...	...
50 ,, ,, ...	15·2	24·8	13·2	14·4	23·4	16·2	12·3	30·8	12·3	15·0	...	...
60 ,, ,, ...	11·2	22·0	17·4	11·0	20·0	19·4	8·4	30·0	11·6	17·2	...	...
70 ,, ,, ...	6·0	18·8	20·8	6·2	17·0	23·4	4·8	29·4	10·8	15·1	...	...
80 ,, ,, ...	2·6	21·2	21·8	4·0	20·8	25·2	2·5	33·0	6·3	10·3	...	...
90 ,, ,, ...	2·0	25·6	26·6	2·0	20·2	23·6	1·0	30·4	1·6	7·0	...	...

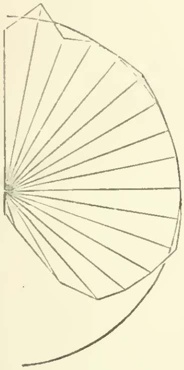
Methven's Screen.—When "plain gas" having an illuminating power between 14 and 22 candles is used, the light passing through the slot is constant, and can be checked by the use of enriched gas, and a smaller slot. The height of the flame is easily controlled.
Suggs' Ten-candle Test.—Variations in the quality of the gas employed do not affect the result, as correction is made for any increase or decrease in its illuminating power.

We have thus the present position of the standard of light controversy clearly defined. The conflict of testimony is so diametrically opposed that an outsider would naturally consider that either there is little disposition on the part of various advocates to admit particular, and of varying luminosity, is most trying. These considerations show that great caution is necessary in arriving at a judgment on the whole question, which should be approached with due regard to the opinions and experiences of others.

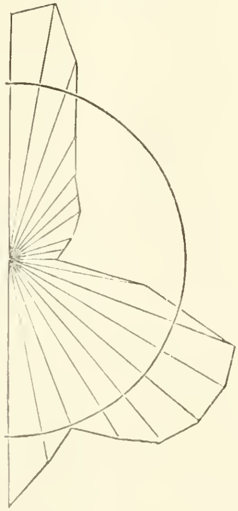
I have spoken previously in favour of a high-power standard, and I see no reason to alter that view, although I gladly admit the facility with which readings were made when the pentane air-gas was employed during my recent experiments. With practice and great care the results are satisfactory, but they cannot, in my judgment, be obtained with the same facility and comfort to the observer as

ARGAND BURNER No. 1.

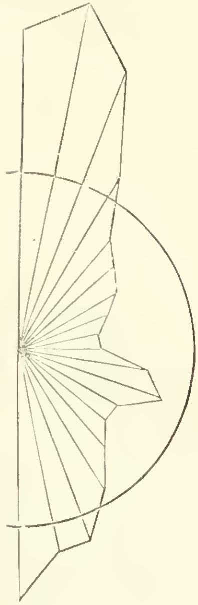
Without Reflector or Cup.



With Reflector Only.

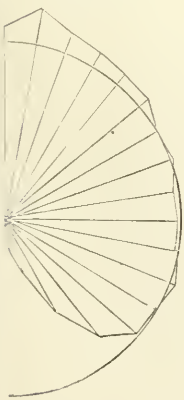


With Reflector and Cup.

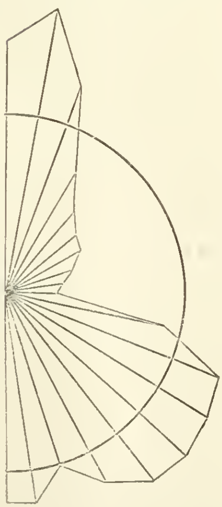


ARGAND BURNER No. 2.

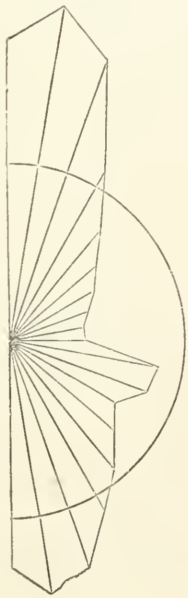
Without Cup or Reflector.



With Reflector Only.



With Cup and Reflector.

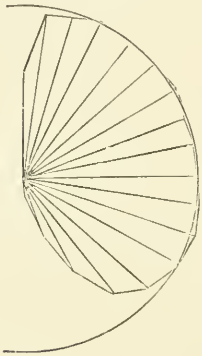


when a higher power standard, such as the "Ten-candle Test," or Keates' lamp, is used.

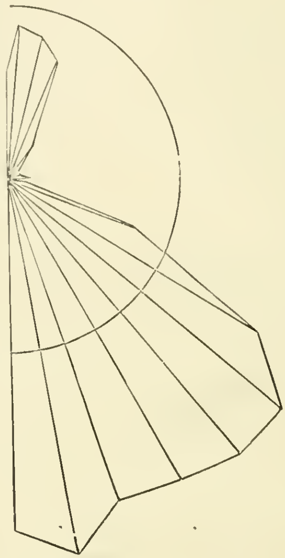
It is highly desirable that the standard combustible employed should be of a definite character. For this reason I do not think that plain coal-gas is admissible. Its constant variation must be a source of frequent liability to error; moreover, a standard of light should be self-contained, and available under all conditions. Circumstances will arise in which coal gas may not be attainable. Many authorities seem to overlook this fact, and speak of a standard of light as if it was solely desired for the purpose of gas testing. I prefer

ARGAND BURNER No. 3, WITH AND WITHOUT CARDBOARD SHADE.

WITHOUT SHADE.

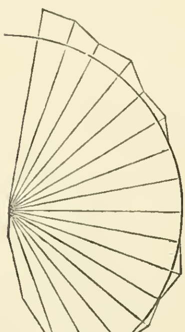


WITH SHADE.

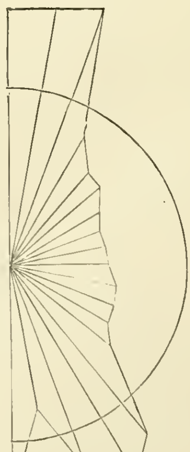


"CHRISTIANIA" GOVERNED BURNER.

WITHOUT OPAL GLOBE.

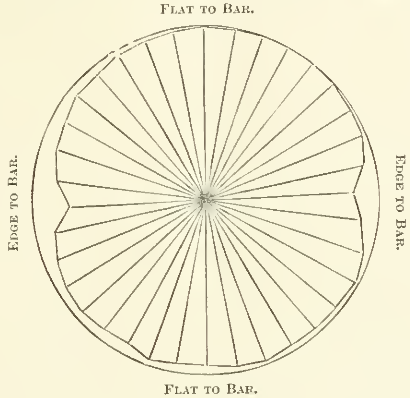


WITH OPAL GLOBE.



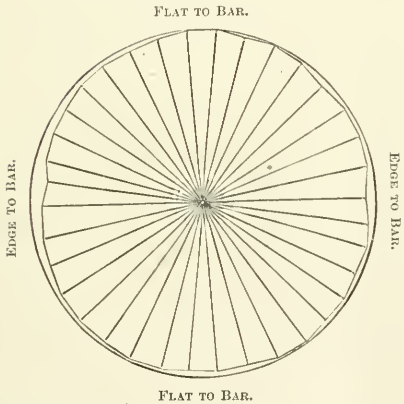
to put the question on a higher footing, and to consider that it should be looked at from all points of view. I therefore eliminate coal-gas from the list of desirable standard combustibles. Under these circumstances I submit that the only combustibles of a reliable character now in question are pentane and sperm oil. The pentane may be used in two forms, either as proposed by Mr. Harcourt, or as proposed by Mr. Methven. In the first instance, Mr. Harcourt, to whom the credit of the introduction of pentane as a standard combustible is due, uses it in the most economical manner, every particle of the

HORIZONTAL RAYS FROM FLAT FLAME BURNER No. 2, WITHOUT GLOBE.

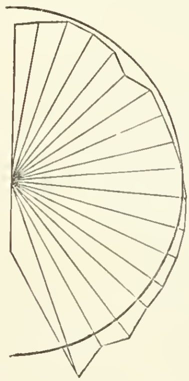


FLAT FLAME BURNER No. 3.

HORIZONTAL RAYS.

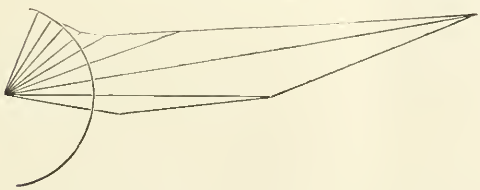


ANGULAR RAYS.

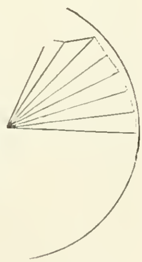


COMPOUND REFLECTOR, WITH No. 4 UNION BURNER.

ANGULAR RAYS.



THE SAME BURNER WITHOUT REFLECTOR.



substance being made to do effective work. In the second instance Mr. Methven uses it in a most extravagant form, utilising only a very small portion of the quantity actually employed. If used with the "Ten-candle Test" of Mr. Sugg, as I have suggested, it would be consumed nearly as rapidly as in Mr. Methven's arrangement, but nearly the whole of it would be made to do effective work. The sperm oil can only be used in the manner proposed by the late Mr. Keates.

These considerations, if generally accepted, narrow the question materially, and so afford hope that the day is not far distant when all differences will be reconciled, and one system universally adopted.

Before the question is finally settled, it is most sincerely to be hoped that the recommendation of the Congress of Electricians, which met in Paris in 1881, will be acted upon in some form, and the question made international. The matter has been under the consideration of a committee appointed by the British Association, but up to the present their efforts do not appear to have met with much success.

The following extracts from M. Monnier's "Étude sur les Étalons Photometriques" form such a valuable contribution to the subject, that I feel that little apology is needed for introducing them here :—

"On summing up the preceding determinations, one sees that one normal English candle consuming 120gr. of spermaceti per hour is equal to 0·120 normal carcel. One normal German candle of paraffin, of which the flame is 50mm. in height, is equal to 0·34 carcel. One normal candle of Munich consuming 10·4grm. of stearine per hour is equal to 0·153 carcel. One 'star' candle of five to the packet, consuming 10grm. of stearine per hour, and giving a flame of 52·5 millimetres, is equal to 0·136 carcel. One 'star' candle of six to the packet, under the same conditions, is equal to 0·132 carcel. The value of the normal carcel consuming 42grm. of oil per hour is therefore equal to 8·3 English spermaceti candles ; 7·5 German paraffin candles ; 6·5 Munich stearine candles ; 7·4 'star' stearine candles of five to the packet ; 7·6 'star' stearine candles of six to the packet. The gas of which 105 litres equals one carcel is equal to 13·2 candles by the English system, and to 14·5 candles by that of Berlin.

"We need not insist on the difficulties that one meets with when comparing the results of first experiments with such variable units, more than on the uncertainty which is attached to the relative value of different standards of light. . . .

"One sees that the system proposed by Mr. Harcourt for representing a luminous standard constitutes an interesting progress towards photometrical measurements, and if the principle of this method were generally adopted, it would be easy to establish experimentally a standard burner representing a definite power of light. This we have done for the use of the laboratory by regulating the burner to a tenth of a carcel, in order to simplify the calculations. But as it would be very important that a work of this nature, for its conclusion, should have the unification of photometric measures, it is to be desired that the experiments to be made in this direction should be undertaken with the assistance of experts who have specially devoted themselves to this question in England and Germany, as well as in France. We should perhaps in this way arrive at the realisation of an international standard of light, the use of which would permit us to arrange and express, in a language understood by all, the result of the researches made in the different countries."

From the results of my experience during the past six months, I am strongly of opinion that the only way to obtain results of a strictly comparative character would be to make an extended series of tests with the proposed standards on a four-way photometer, by which means one central light would be tested simultaneously by four different standards. It would be highly desirable that the observations should be conducted by as many competent photometrists as possible, each of whom should have considerable preliminary practice with all the standards to be tried ; as however competent an observer may be with a standard with which he is acquainted, he cannot possibly be expected to obtain the best results with an entirely novel apparatus. The desirability of this latter proposition is strikingly shown by the results of the tests made by M. Monnier with the English candle, the results obtained by that gentleman being evidently of an exceptional character. M. Monnier states that the normal carcel is equal to 8·3 English spermaceti candles, whereas, as I have stated, Mr. Sugg in 1870 made it equal to 9·6 candles, and I have recently found it to be equal to 9·41 candles. The wide divergence of M. Monnier's results from those of Mr. Sugg and myself, is only another powerful argument for the speedy settlement of the question.

In submitting these general conclusions and suggestions to the Society, I have not thought it desirable to encumber the question with tabulated statements of the results of numerous experiments, but I have rather desired to deal with the subject from a broader point of view—with general considerations instead of minute differences. It is most sincerely to be hoped that experts and inventors will dismiss all personal rivalry and join in a combined effort for effecting that which all admit to be so desirable. I would most earnestly plead with all to abstain from anything which might convey a personal reference beyond matters of fact. I am sorry to have noticed remarks which can never contribute one iota to the solution of a question of so pre-eminently difficult a kind as that of the standards of light. For my own part I have deemed it but just to the memory of one who is with us no longer, to put his proposal clearly before the public; I refer to the Keates lamp, and in doing so I have only discharged that which I felt to be a duty. Whatever may be the results of future work in this direction, I shall endeavour, as I have done in the past, to obtain undoubted evidence of the truth, and to uphold that standard which prolonged experiments shall show to be most trustworthy in all respects. Whether this standard be one of those now proposed, or some future device, is a matter of perfect indifference to myself, as I hope it is to others. The question is an international one, and if settled upon a broad and permanent basis, it will be lasting, and a credit in future ages to the present time.

Note.—Since the date of the above paper, the author has been instructed by the Metropolitan Board of Works to carry out a further series of experiments by means of a four-way photometer as recommended by him.

DISCUSSION.

The CHAIRMAN said they had to thank Mr. Dibdin for a most interesting and suggestive lecture on two very important subjects. The first part of the lecture, dealing with the use of the radial photometer in studying the distribution of light, appeared to him to be one which all would do well to pay more attention to, and particularly those who had the arrangement of lighting specially large buildings. As a rule, the great object of lighting a large building seemed to be to provide that the greatest possible amount of light should be thrown into the eyes of the unfortunate audience, and as much as possible introduced between them and the speaker or musician they were

listening to. If this was what was wanted, the arrangements approached nearly to absolute perfection. It seemed to him that the very simple idea of a radial photometer was the only method by which these common mistakes in the arrangement of lights could be avoided. Of course, if for private study people liked to have the light in their eyes no one could object; but he thought, even from a very little study of the elementary principles of how light fell—nothing near so perfect as Mr. Dibdin had given—people might save their eyes a great deal of weariness. One point which all would do well to bear in mind was that the eye was not a photometer, or rather that it was too perfect a photometer. The effect of a certain limited amount of bright light in closing the iris was most extraordinary; and very often the exceedingly dogmatic opinions which were heard as to the perfection or imperfection of particular lights, depended more on the question of whether the light was so arranged as to act upon the iris or not, as to any other cause. The light full in one's eyes contracted the iris, and diminished the amount of light falling on the retina from a less brilliantly illuminated surface. The question of the photometric standards was very interesting, and had several very important bearings. The mere question of whether gas was or was not an exact standard was only one detail. When we come to consider the relative advantages of different systems of lighting, or the relative value of different illuminating substances, this question was of the first importance; and it was only by such careful and accurate work as Mr. Dibdin had described that a conclusion could be arrived at.

Mr. Vernon Harcourt said the radial photometer was really most admirably contrived, and calculated to do excellent service, and the determinations it afforded were very well illustrated by the length of the rays on the diagrams which had been shown, which brought before one, almost for the first time, a clear idea of the effects of shades and globes with which they had been so long familiar. Although he knew the effect of putting a shade over a lamp must be to throw more light downwards, and to diminish the amount of light spreading horizontally, he had never represented that effect to himself quantitatively, and could not have gained so clear an idea of it as he had gathered from Mr. Dibdin's diagrams. With reference to the standard of light, the point of greatest importance was that an effort should be made to have this question further investigated; and also that there should be some prospect of definite action being taken in the matter. The only reason, as far as he knew, for retaining the sperm candle in its present position was that it was specified as the standard by Act of Parliament, and must be continued to be used for the official business of gas testing until some change was made in the law. The Board of Trade instituted an inquiry some years ago, when a report was made to them, but, for some cause or other, no action had been taken upon it. He believed the reason was that which had stopped many more important matters—the exceeding difficulty of getting any measure through Parliament if there were any likelihood of opposition to it. Unless not only gas consumers, but gas companies also, were convinced that a change of standard was desirable, there was no likelihood of a Bill being brought forward on the subject which would pass through Parliament. Still, it was a most unsatisfactory state of things that they should be bound to use a standard of a most unscientific and unsatisfactory character, simply because it was connected with a large industry which had been established by law, and because there was great difficulty in getting the law changed. He hardly liked to speak of the demerits of the candle; but all who had had to do with photometry must be aware that their best efforts were wasted in attempting to obtain exact results with candles. All the rest of their apparatus might be of a very perfect character, but so long as the standard with which other lights were compared was continually and miserably fluctuating whilst in use, the results could not be in any way satisfactory. It was wonderful that testing should be constantly going on with the object of seeing that the gas was up to the standard, and that men were working carefully and conscientiously at it, when they could not but have learnt quite early that their best endeavours were futile, and that the figures they were obliged to send in represented very little indeed. He hardly liked to enter on the question of the general merits of the various standards, as he was particularly interested in one of them; but he might say that until Mr. Dibdin's recent work was published he had no idea how excellently constant a light could be obtained from such a lamp as that which Mr. Keates had devised. He had formerly been prejudiced against standards in which the use of a wick was involved, because it would seem that variations in the plaiting of the wick, and variations arising from the difference in the length of time which had elapsed since the lamp was trimmed, together with small variations in the structure of the lamp, or position of the chimney, would lead to considerable variations in the amount of light it gave; but all such anticipations must yield to the facts of the testings Mr. Dibdin had recently produced, and reported to the Metropolitan Board, which showed that though these variations might occur, and the light might vary considerably, yet, by making a simple proportional correction for the amount of sperm oil consumed in the lamp, and assuming the amount of light given was directly proportional to the amount of oil consumed, and making the comparison between the corrected light and another flame from stored coal gas, it was evident that the light given to the lamp when the corrections were applied was of very great constancy. He was, therefore, fully convinced that this lamp deserved to take a high place amongst standards.

Mr. Methven said he was fully alive to the importance of the idea suggested by Mr. Dibdin of the desirability of having these standards more carefully and closely investigated; and it would be a grand thing when a standard was introduced which would put the sperm candle on one side altogether. With reference to Mr. Dibdin's recent experiments, he desired to refer especially to the results obtained by different operators. They could not but notice, in following the figures given by Mr. Dibdin, the great difference in the results arrived at by different operators; and this, he thought, was a very important point. His conviction was that the difference in results might arise in consequence of the different photometers with which they worked; and he was strongly of opinion that, before the question of a new photometer could be determined, it was absolutely necessary that some investigations should take place with reference to photometers themselves. He thought these differences obtained by different operators were in great part, if not entirely due to the disc which was at present generally used; and that if a little attention were devoted to this subject a better form might easily be introduced. He had been considering this question lately, but his investigations had not been extended sufficiently to warrant him in coming to any definite opinion. His impression was that much better results would be obtained if, instead of judging of the illumination of an opaque

spot in the centre of a greased paper, they had the opportunity of determining the depth of a transmitted shadow. He placed a piece of blackened tin at the same distance from the disc on either side—there being two pieces of tin on one side of the disc and one on the other—in order that the two shadows should not be thrown upon one another; and he found very great facility in determining the exact position of the discs by means of these transmitted shadows. It was much easier to arrive at the correct position of the disc by this means. When it was remembered that shifting the position of the disc 0·1 inch made a difference in the readings of $1\frac{1}{2}$ per cent., it showed how carefully this point should be considered when the time arrived for the different standards to be investigated. If the operator had the screen obscured from his vision, he would have great difficulty in bringing the disc in half-a-dozen readings within 2-10ths of the actual position. This brought him to another point of great advantage likely to be derived from a high-power standard. In using such a standard the disc was brought down into the wider space, and the distance of 0·1 inch or even a $\frac{1}{4}$ of an inch made very little difference in the result of the readings. This led him to consider the question of another form of photometer; and at present he was engaged on some experiments with one in which the standard and the disc were fixtures, and the light to be tested was movable. In a photometer of the ordinary length of the Letheby photometers—60 inches—he found the difference of the point on the bar of fifteen or sixteen candles was about $1\frac{1}{2}$ inch. This $1\frac{1}{2}$ inch divided into tenths of a candle was a perceptible distance, and he maintained that 0·1 inch, in the difference of light under those circumstances, would not make any serious difference. On the other hand, the distance upon the bar between fifteen and sixteen candle gas, on a 75-inch photometer, was only about half-an-inch, and the difference of 0·1 inch in placing the disc would make a difference of $1\frac{1}{2}$ per cent. in the readings. Of course with a 60, 50, or 40 inch photometer the distance decreased, and a difference of 0·1 inch became very serious. He suggested having the standard and disc fixed, and the light to be tested movable. With a photometer of this kind you could measure 500 candles, or even an electric light, if you had provisions for taking it far enough away, the standard remaining constant all the time.

Professor Foster was very pleased to hear that Mr. Dibdin was continuing these investigations, particularly with regard to the reflection of surfaces, which was a subject of great importance at the present time, because extraordinary statements were made in the public press respecting the illuminating power of new lamps which were brought out from time to time. In many of the recuperative forms of lamps there was a reflector as well as the recuperating influence at work; and, before you could arrive at any scientific figures relating to recuperation as applied to illumination of the amount of light gained by reflection ought to be eliminated. He was referring to a number of lamps, which were familiar to gas engineers, in which the reflecting surface formed part of the lamp, and had a very marked effect; but the manufacturers dealt with the whole thing as a lump sum, showing the enormous amount of lighting power in a particular direction, not saying a word as to what reflection was doing, and what the true lighting power of the lamp might be. This was very important in considering special reflecting metallic surfaces made for a particular occasion, which might only last for that time, but would not do so much longer. With regard to the question of standards he was almost afraid to say anything on behalf of candles; but he might remark that the first time he contributed anything to the *Chemical News* was in 1870, and it was with reference to sperm candles. There was an old proverb to the effect that threatened men live long; and he feared that the extraordinarily strong feeling in certain directions for a particular standard, only made the prospect of the life of the sperm candle still more favourable. It was extraordinary that something was not done to improve these candles. He did not know whether they were at all defined, but, if so, very little care was taken in their manufacture, so far as knowing the actual composition of the material, or the conditions of the manufacture. All were impressed with the importance of having a standard which could be produced under stated conditions. The air-gas standard was of this class; but still it was limited in many instances. They wanted a portable standard; and, for such purposes, the Keates lamp might be a very important function. Another important point was not to allow a great disparity to exist between the thing measured and the standard; and this seemed to have been overlooked in many instances. In dealing with large lamps, such as those of Sir James Douglas or of Mr. Siemens, a candle could scarcely be taken as a standard; in such a case the errors of observation became very marked, and, therefore, as a principle, there should be some comparison between the amount of light to be measured and the unit employed. The candle lamps devised by Mr. Harcourt might be admirable for measuring the gas in general use; but it would be very difficult to work with the standard for other special and technical purposes.

Mr. Hartley thought Mr. Dibdin must have said more than he intended when he said that, anterior to these testings, there had been no estimation of the amount of light at different angles. In his own vindication he must say that in the year 1881 he published a series of three articles in the *Journal of Gas Lighting*,* one of which was especially devoted to the effects produced in the measurement of light at different angles. The difference between the measurements, then, and those of Mr Dibdin consisted in this, that, wanting himself to know the difference in effect produced in lighting a vertical surface, he used a vertical screen, but, nevertheless, he had a photometer which enabled him to measure the amount of light from flames at any imaginable angle above the discs. Mr. Dibdin had gone a little in another direction, and was able to estimate the value of light coming upwards to the disc; but, as most of the lights in use were above the level of the eye, the most important determination was certainly that which dealt with an overhead flame. In ordinary estimations of light power, the light was measured horizontally, as when gas was tested for its illuminating power. At the same time he (Mr. Hartley) cited some experiments showing the effects obtained by reflectors of different forms, and gave illustrations of their effects. He then remarked that the screens placed in the base of an Argand flame generally made the light more soft and agreeable; but that the use of a reflector above cut off a tremendous amount of light. Again, he said, for the general lighting of rooms and offices, reflectors should be made so as to deliver the rays in a manner analogous to that which Mr. Dibdin had depicted. He claimed, therefore, the merit of having directed special attention to the necessity for measuring flames in various ways; and, in the same paper, drew attention to the fact, which did not seem to have been observed before, that,

* See "Observations on Glass, as an Obstructor and Reflector of Artificial Light," by Mr. F. W. Hartley, A.I.C.E.; and *Journal of Gas Lighting*, Vol. xxxvii. pp. 54, 94, 130.

in dealing with flames at different elevations, it was very necessary that the angle should be regarded. Referring to the amount of light indicated in different directions by different burners, he said the diagrams were very beautiful; but the fact was known as far back, he believed, as 1856, to Mr. F. J. Evans, who made the first experiments with respect to flat-flame burners, and who announced that the edge of the flame yielded less light than the side. Since that time a number of others had observed the same thing. In 1881 he made a large number of tests with paraffin lamps, in which he referred to the effects produced from the flat sides and the edges. In this respect he differed from Dr. Redwood and his son; because he found the difference less than they did; and, although a gas man, he was quite ready to render justice to the lamps which he tried. Coming now to the various standards of light, he had been associated with Mr. Heisch in testing the standards under the authority of "The Gas Institute," and both of them, though most unwillingly, felt compelled to say something adverse to Mr. Harcourt's pentane standard. Mr. Dibdin had, during the evening, tried an experiment, with the view of showing that the Harcourt air-gas was not subject to vibration; but he should remark that, in their report, Mr. Harcourt and himself drew a distinction between the two kinds of standards—the lamp standard and the air-gas standard—and stated that it was the lamp standard which was specially subject to vibration. The lamp was now presented in a different form to that which they experimented with. It had then no top chimney, only one at the base; and the consequence was that it simply directed an upward current of air to the flame, which was more liable to vibration. M. Mourier, in testing candles, found the French lamp equal to about 8½ candles; but Mr. Sugg and himself made it 9½, and Mr. Dibdin 9·4, so that there seemed some difference in the usage of candles, or, perhaps, candles gave more light now than they formerly did. He had not had an opportunity of trying the Keates lamp at the time he was invited to do so; and afterwards he was not able to use it. He was surprised to find, in respect of the Methven standard, that, while Mr. Dibdin said it showed considerable variations, he found that, with a cut-off flame, which, after all, was little more than the Methven standard in another form, he got constant light. The Keates lamp was used with a cut-off flame; and, taking the Methven screen out, they were told that it would give a light of four or five candles at will. Now, if one flame could do it, why not another? Certainly the flame varied to some extent with the quality of the material burnt. But it had been proved that the quality of the material might differ to a very large extent; for it was shown by the Board of Trade investigations some years ago, that at least the difference of two or three candles might be caused by gas of different qualities, and yet the same light was yielded through the modern slot. He was decidedly at issue with those who advocated a high-power standard. He found it much more comfortable to use a comparatively low power than to use a high one, the effect on the eyes being less powerful. Again, it was a question whether with a high power the eye was not satisfied much more easily than with a low power; and, therefore, differences, which might exist, were not so easily discoverable. It was easy to weigh tons, but comparatively difficult to weight fractions of a milligramme, and it seemed to him that the same thing held good with respect to photometry. Differences were really found when standards of comparatively low power were used, which were undiscoverable with standards of high power. This consumption would apply to what Mr. Methven had said with regard to the advantages of wide spaces. This question would, no doubt, in the end be settled under the direction of a Parliamentary Committee, when all those interested in the matter would be called together. It was certain that, up to the present time, there was no bitter antagonism on the part of any of the operators engaged in these investigations. They were all anxious to arrive at the truth; but circumstances rendered the determination difficult, if not impossible, but when they all got together, they might, perhaps, arrive at it. Mr. Foster had touched on the question of reflection, and he also wished to emphasise the importance of this matter; and, when burners were being tested, it had been specifically stated when reflecting surfaces were used, and it had also generally been shown what the effect of these surfaces was within a certain area. Mr. Foster was certainly right in saying that there ought to be specific statements as to the effect of reflectors.

Dr. PERKIN said he was not specially conversant with this matter; but, in working a polariscope, he had found that when the light was very strong there was a difficulty in getting accurate readings, and if it were very weak it was very trying to the eyes. He should therefore think the happy medium was the thing to be aimed at in most cases where the eyes were used.

Dr. PERCY FRANKLAND said it seemed to him that photometric observations with reflectors must be considerably misleading, unless the precise circumstances of the case were always given; because with certain kinds of reflectors you would get an entirely different observation according to the length of the photometer. If the source of light were placed at different distances from the screen, that would give entirely different readings to what it would if placed at another distance. The length of the photometer, in fact, was the actual factor in the determination. In all cases where burners were tested the reflectors should be discarded altogether, and special statements made with regard to the effect of particular reflectors which were recommended. With regard to the standard of light, he had generally used candles and a Methven screen, but it seemed to him a very important matter to have a standard of light at any rate approximately equivalent to the light to be tested. This was really a mathematical question. It was evident that when the source of light and the standard were nearly equal, any deviation between them would give readings very much larger than in the opposite case. It was like making an analysis with a large quantity of the substance; and they all knew how much more accurate the results were when the quantity of the substance employed was large than when it was very small. Of course, there was also the question which was most agreeable to the eye; and there could be no doubt there was a certain happy medium in that matter. You could not for a long period of time look at a source of light like a Keates lamp with the same comfort that you could look at the standard candles or the Methven screen. With regard to Sugg's ten-candle standard, he was much interested to hear that the light remained the same in spite of changes in the richness of the flame. He had had occasion, recently, to take the illuminating power of gases of great richness, and when doing so had been struck by the large space of blue flame at the base when burned in the ordinary Argand burner; but he had not been prepared to hear that this increase in the blue portion of the flame was so exactly in proportion to the richness of the gas.

Mr. Whitley Williams exhibited a lamp to which his attention had been drawn by Mr. Frederick Siemens, having been devised by Dr. Von Hefner Altneck, for the purpose of measuring the electric light. It possessed many of the advantages of Mr. Vernon Harcourt's pentane standard, but, in some respects, it was much more simple. It was essential, with a photometric standard, that the substance burnt should be of absolutely definite composition; and it was equally requisite that the amount of light given by it should be in exact proportion to the amount of substance burnt. In this case a sufficiently complete and extensive series of experiments had not yet been made to demonstrate this completely, but he had seen enough to be able to say that the light was an extremely good one—in fact, enormously better than that given by standard candles. These candles had been almost universally condemned, but it had always appeared to him remarkable that although enormous pains were taken with the apparatus, very little pains should be taken to control the standards they had to use. He had been obliged to reject more than one-third of the candles supplied to him, and one which he had brought with him was utterly unfit for use, the wick being out of the middle of the candle. It seemed to him rather remarkable that, whilst they were compelled by Parliament to use these candles as the standards, there were no conditions imposed as to the way in which the candles should be made. A great deal also depended on the way in which the candles were burnt. This lamp was made to burn amyl acetate. A tube of German silver, of a given thickness and diameter, was inserted in the lamp, and the thickness and construction of the wick did not materially matter. The flame was regulated to the height of two pointers, and could be very easily adjusted. After about ten minutes' burning the flame remained constant for eight hours with hardly a shade of difference, and when it had burned for this time the wick itself showed no signs of charring. That arose from the fact that the boiling point of amyl acetate was enormously below that at which the wick even began to be charred, or browned, and in that respect, at all events, the lamp was an admirable one. It was not by any means absolutely necessary that the amyl acetate should be particularly pure. If butyl acetate was taken, the next lower homologue of the series, the amount of light given out by the lamp was ·99 of that given when pure amyl acetate was used. He had suggested to Mr. Siemens that the lamp should be made simpler, as it now weighed nearly 1 kilo., and he believed it might then be made very serviceable. Dr. Von Altneck was very anxious to correlate this with the English candle in use, and he found that by adjusting the height of the flame to about 40mm. from the edge of the metallic tube the light was almost exactly equal to English sperm candles. He had used this from time to time in the intervals of testing the gas of the Metropolis, and the results very fairly agreed. He found one reading always came within 1½ per cent. of the mean of 300 tests.

Mr. Dibdin, in reply to Mr. Methven, said the differences observed by different operators were not due to their having used different photometers, the tests to which he referred having all been made on one photometer and one disc. Mr. Hartley seemed to think he was under the impression that no photometer had been used for testing angular rays previous to the introduction of the radial photometer. It was quite true that Mr. Hartley made some tests in 1881, but they were made on the vertical disc; and he had before pointed out to the Society, and might point out once more, how important the position of the disc was. If the light were above the vertical disc, the horizontal rays would have no value. It was Mr. Hartley's "Universal" photometer, as altered by Professor Foster and himself, which led to the present form. He had not the slightest doubt that, as Mr. Hartley had said, the difference between the light given by the edge and flat side of a flame had been proved before; but he thought it would be interesting to make some further tests for his information, if not for others. He did not claim any special merit or novelty in that matter. He hoped the time would soon come when Mr. Hartley would be able to make tests with the Keates lamp. He should remark, however, that the Keates lamp with a screen was not the lamp as devised by Mr. Keates, which was a 16-candle lamp. The screen was a suggestion of Mr. Sugg's; but he (Mr. Dibdin) did not much approve of it, although he believed it had been found to give very good results. Variations in the character of the flame, which was not of any importance when the total consumption of oil was taken into account and the corrections made, were very serious when only a small portion of the flame was taken, and no correction made for the consumption of oil. Dr. Percy Frankland had pointed out a very important matter in connection with reflectors. It was, no doubt, necessary, in all such cases, that the length of the photometer bar should be taken into account; and, in any comparative experiments with different screens, the same length should be used in all cases. It would be ridiculous to test one reflector on a 50-in. bar, and another on a 200-in. bar. What he claimed for the radial photometer was that it gave the opportunity of testing to every degree; but, in the diagram showing the effects of the compound reflector, he had only taken one or two points to give the general effect, showing whether the maximum light was up, down, horizontal, or in what direction. In regard to a powerful flame being very trying to the eyes, it, no doubt, was so, if the operator were foolish enough to stare at the light. But, in making photometric observations the operator only looked at the light occasionally to see if it was burning properly, and then he should only do so through coloured glass. The observer could not read the disc properly if he looked at the light. The eye should be carefully shaded in every way, and operators who were not careful about this matter would never get reliable results.

The Chairman then proposed a vote of thanks to Mr. Dibdin, which was carried unanimously, and before the proceedings terminated, the latter gentleman showed and explained the action of the radial photometer.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: J. Campbell Brown.

Committee:

Ernest V. Bibby.	C. Symes.
Hudson A. Binney.	G. I. J. Wells.
Eustace Carey.	F. Hurter.
John Hargreaves.	H. Brunner.
E. Milner.	A. Norman Tate.
E. W. Parnell.	J. Affleck.

Local Sec.: E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Manchester Section.

Meeting held Tuesday, March 24, 1885.

SIR HENRY ROSCOE IN THE CHAIR.

ON THE ESTIMATION OF TANNIN.

BY BERTRAM HUNT.

In the following memoir I propose giving a modification of the method of estimating tannin by permanganate. The modification consists in the method of precipitating the tannin previous to the titration for "matters oxidised other than tannin." Procter, (*Journ. Soc. Chem. Ind.* iii. p. 82), in order to precipitate the tannin, adds to 50cc. of the tannin solution 28·6cc. of gelatin solution and 10cc. of dilute sulphuric acid. He then saturates the liquid with salt, adds a little kaolin, and shakes thoroughly. He thus precipitates all the tannin, and almost all the gelatin present, and on filtering gets a clear bright filtrate. I have found, however, that in order to get a clear, tannin-free filtrate, it is unnecessary to saturate the liquid with salt, and that, in the case of materials containing any considerable quantity of gallic acid, the results are too high owing to the precipitation of some of the gallic acid. The following method gives a liquid which filters easily, and the filtrate is perfectly clear, and free from tannin. 50cc. of the tannin solution are run into a small dry flask; to this 25cc. of a fresh filtered solution of gelatin (2grm. per 100cc.) are added, and the flask shaken. 25cc. of a saturated solution of common salt, containing 50cc. of strong sulphuric acid per litre, are now added, and about a teaspoonful of pure kaolin or baric sulphate. The flask is now thoroughly shaken for a few minutes. The solution filters easily and quickly, and the filtrate is clear and bright.

In order to compare the two methods, the following experiments were made:—A solution of "pure tannin" was made of a strength of 10grm. per litre. On analysis this solution gave, by Procter's method, 0·8940grm., and by the modified method 0·8937grm. tannin per 100cc. These numbers are calculated on the supposition that 63grm. oxalic acid = 41·57grm. gallotannin. To 9 volumes of this solution was added 1 volume of a solution of 10grm. gallic acid in 1 litre water. On analysis, this second solution gave, by Procter's method, 0·8176grm., and by the modified method, 0·7956grm. tannin per 100cc. To 8 volumes of the tannin solution were now added 2 volumes of gallic acid solution. The resulting solution gave, by Procter's method, 0·7399grm., and by the modified method, 0·7111grm, per tannin per 100cc. These results prove, I think, the precipitation of gallic acid along with tannin in Procter's process, and the following results confirm it. A solution of 5grm. gallic acid per litre water was made. On going through the process of precipitating tannin by Procter's method with 50cc. of this solution, it was found that 18·48 per cent. of the gallic acid was precipitated, while by the modified method only 3·18 per cent. was precipitated. When the gallic acid solution was of a strength of 1grm. per litre, by Procter's method, 17 per cent. was still precipitated, and by the modified process only traces.

As regards the titrations with permanganate, the method of working recommended by Procter gives perfectly satisfactory results. With practice, results of duplicate titrations, agreeing to ·05cc., can always be obtained.

A good method of extracting the material to be tested, is to weigh out an amount of substance rather less than 20grm., extract by boiling half-an-hour or so with about a litre of water, wash and make up the clear cold solution to a strength corresponding to 10grm. per litre. For the estimation of the "total matters oxidised by permanganate," it will be found that, if some of the solution of above strength be diluted 10 times, 10cc. will be a convenient quantity to titrate along with 20cc. of indigo solution. For the estimation of "matters other than tannin," if the material contains more than 45 per cent. of tannin, it is advisable to take only 25cc. instead of 50cc. of the tannin solution, and 50cc. instead of 25cc. of the saturated solution of salt, the amount of gelatin solution added being the same (25cc.). The gelatin solution must, in all cases, be freshly prepared and filtered.

In the case of gambier and allied materials, precipitation by gelatin and salt does not remove from solution all that is of "tanning value," as the following experiment shows:—200grm. cube gambier were shaken till dissolved in a litre of water at 60° C. The solution was then allowed to stand 24 hours, and the clear liquid syphoned off. The sediment was stirred up with some cold water, and again left to settle. This treatment was repeated till the clear liquid gave no precipitate with gelatin. 100cc. of the clear liquid were then placed in contact with 5grm. of "pure dry skin." By titrating the liquid with permanganate before and after contact with the skin, it was found that 68·66 per cent. of the "matters oxidised by permanganate, as oxalic acid" had been absorbed by the skin. The best substance for abstracting the tannin from solution in the case of this material is pure dry skin shavings or powder; and if the skin be prepared in the following manner, constant and concordant results can be got:—Selected pieces of pelt, as they come from the "bate," and are ready for the tanpit, are freed from adhering flesh, and soaked for an hour or so in water slightly acidulated with acetic acid. The pieces of pelt are then thoroughly washed with frequently changed quantities of distilled water till free from acid. They are then soaked for 24 hours in clean methylated spirits. After squeezing, they are soaked in "alcohol distilled over lime" for another 24 hours. The pieces are now dried thoroughly at a low temperature, and brought to a state of fine division by planing or otherwise. To perform an analysis 5-6grm. of the dry pelt are put into a small flask, with about 100cc. of the gambier solution, containing 10grm. gambier per litre. The solution is kept in contact with the pelt for at least 12 hours, and the pelt then filtered off. The filtrate is then titrated for "matters other than tannin" in the usual way.

As there appear to be few reliable analyses of tanning materials by the permanganate method published, I give below some results got by me in testing different materials. The tannin was estimated both by Procter's method and by the modification described in this paper. Both methods were worked simultaneously with the same solution of the respective tanning material, so that the results are strictly comparable. The filtrates from the gelatin precipitates were in every instance tested for tannin, but in no

instance was any found. They were also tested for gallic acid by potassic cyanide solution (S. Young, *Chem. News*, 48, 1234, p. 31), and in the case of those materials containing a relatively large amount of "matters oxidised other than tannin," the colouration, in equal bulks of solution, was distinctly less intense in that from which the tannin had been precipitated by Procter's method than in the other.

On referring to the following table of analyses, it will be observed that the difference in the percentage of tannin found by the two methods is greatest in the case of those materials containing a relatively large amount of "matters other than tannin oxidised by permanganate."

The "total extract" in the following table was determined by evaporating a portion of the tannin solution to dryness in a small porcelain basin and drying the residue at 110° C. The "insoluble matter" was also dried at 110° C.

DISCUSSION.

The CHAIRMAN: You are all aware that there are considerable difficulties in the determination of these very important substances. The subject has already received the attention of our Society in a paper which was read by Mr. Procter before the Newcastle Section, and which is published in our Journal. Mr. Hunt's method seems to be an improvement on Mr. Procter's, and I hope it is a method which can be entirely relied upon.

In reply to several questions by the Chairman, Mr. HUNT said: Gambier and similar materials contain a large proportion of "catechin" or similar bodies which are not precipitated by gelatin, but are of tannin value as they are absorbed by skin. It is true that these bodies are precipitated almost completely by the addition of salt and acid to the solution, but matters of no tannin value are also

NAME OF MATERIAL.	Total matters oxidised by Permanganate, as Oxalic Acid.	Tannin (Procter), as Oxalic Acid.	Tannin, as Oxalic Acid.	Total Extract.	Insoluble.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
English Oak Bark	15·70	13·51	11·97	18·38	66·15
Canadian Hemlock Bark	9·03	7·46	7·08	13·96	75·25
Larch Bark	8·20	7·17	6·15	20·61	60·80
Mangrove Bark	31·35	29·71	28·18	26·60	49·70
Alder Bark	8·27	6·15	5·73	19·36	68·00
Blue Gum Bark	10·18	8·91	8·91	11·76	71·65
Valonia	37·41	35·21	30·50	38·50	46·05
Myrabolans	48·23	38·43	38·00	42·80	—
Sumach	42·53	34·30	31·16	41·10	47·77
Betel Nut	15·91	13·87	13·79	17·94	67·00
Turkish Blue Galls	73·38	65·83	59·96	48·10	36·35
Aleppo Galls	98·85	87·82	83·05	68·80	11·32
Wild Galls	26·21	18·75	16·56	31·70	54·17
Divi-Divi	66·98	62·62	61·22	51·38	29·90
Balsamocarpon (poor and old sample)	50·49	37·76	32·88	57·14	28·25
Pomegranate Rind	27·58	21·18	23·12	41·00	49·50
Tormentil Root	22·27	20·98	20·68	19·70	67·95
Rhatany Root	22·27	20·15	19·30	18·80	66·00
Pure Indian Tea	23·06	18·65	17·40	34·46	53·10
Pure China Tea	18·03	14·21	14·09	24·50	62·60
Cutch	57·65	51·95	44·21	61·60	4·75
Gum Kino	66·39	59·55	51·55	79·30	1·00
Hemlock Extract	35·16	33·17	30·98	48·78	—
Oakwood Extract	33·49	26·90	23·86	37·78	—
Chestnut Extract	39·77	32·63	28·88	50·28	—
Quebracho Extract	48·22	41·45	40·81	49·00	—
"Pure Tannin"	135·76	122·14	121·93	—	—
Tan Liquor, sp. gr. 1·030	4·84	3·14	2·10	6·01	—
Spent Tan Liquor, sp. gr. 1·0165	1·40	0·37	0·25	3·10	—
			Absorbed by Dry Pure Skin.		
Gambier, Cube	70·12		51·07	71·40	5·31
„ Sarawak	63·13		47·09	70·70	3·67
„ Balo	56·00		43·70	63·54	1·40

precipitated. Skin does not thoroughly absorb tannin, at least in many cases it would take fully twenty-four hours. In the case of gambier it is absorbed very quickly.

Mr. Grimshaw: Although I have not been able myself to do much in the way of research upon the estimation of tannin materials, I have had at times a number of such analyses to conduct, and have almost always adopted Mr. Procter's modification of Löwenthal's method. I have certainly found that something interfered with satisfactory results being obtained, but it did not occur to me that this was owing to the different quantity of salt used. I should like to ask Mr. Hunt two questions in relation to tannin materials. The first is as to whether he has made any experiments with regard to ascertaining if there is much difference between the results which he gets when the tannin is abstracted by skin or similar material, and by re-drying and weighing the horn, skin, or pelt itself? Of course we are not properly acquainted with all the materials which are taken up in the process of tannin, and it would therefore be of great interest and value to compare the valuation of the material by chemical analysis with that represented by the increased weight of the skin itself. The second question I should like to ask is whether Mr. Hunt could give us a little information as to how he selects and prepares the indigo which he uses as an indicator? Of course it is pretty well known that certain descriptions of indigo are not equally suitable for showing the point at which oxidation is finished. Some samples you may take, particularly those which give a brownish shade, interfere with the determination, and I find it difficult to get an indigo which will act satisfactorily in showing the end of the oxidation of the tannin materials.

Mr. Hunt: As regards the first question, I have made a series of experiments, and have found in many instances the results agreed very well. Procter's results were always too high. In some instances the results by my method were lower, and in others slightly higher, than those got by absorbing the tannin with skin.

Mr. Grimshaw: There is also a method of forcing the liquor through one or more skins. It is a modification of Hammer's method, and was introduced by Müntz and Ramspacher with a special apparatus for the purpose.

Mr. Hunt: For most materials the method is perfectly useless. With some materials the skin only absorbs a portion of the tannin, as proved by Procter and others. Gambier is the only material for which this method is of any use at all. With regard to indigo, I get the best indigo carmine and dissolve it in hot water, and the strength I use is about 5grm. per litre, with 50cc. strong sulphuric acid, and this has given satisfactory results. You should test the indigo, and reject any that gives the brown colour with permanganate to such an extent as to interfere with the end reaction. Löwenthal, the originator of the permanganate process, used a solution of salt and gelatin to precipitate the tannin. Procter adds a solution of gelatin, then dilute acid, and then saturates the liquid with salt, and thus gets a liquid easily filtered. In my process I add gelatin solution to precipitate the tannin, and then a certain proportion of a saturated solution of salt containing acid, and thus get a liquid which filters as easily as by Procter's method, but the gallic acid present is not precipitated, or at any rate to a far less extent than in the case of Procter's method.

Mr. Siebold: I should like to ask Mr. Hunt whether in his determination the tannin alone is determined unaccompanied by colouring matter? I have made many determinations of this kind by means of gelatin without the addition of salt, and have always observed that a considerable portion of the colouring matters present in such substances as sumach, myrabolams, divi, valonias, galls, etc., are precipitated along with the tannin, while the filtrates from the gelatin precipitates appear comparatively colourless. When I worked with a solution of pure tannin, and then repeated the experiment with the addition of colouring matters free from tannin, there was always a notable difference in the result, more gelatin solution being required in the latter case than in the former. In the case of divi and similar substances rich in colouring matter, the amount of tannin thus found may be as much as 50 to 100 per cent. in excess of the actual proportion of pure tannin present. As already stated, I have never applied salt in these determinations, but have simply used a standardised gelatin solution containing a minute proportion of alum. The liability to error arising from colouring matters is, however, not confined to the gelatin process, but is shared by almost all the other technical methods for the estimation of tannin. I have obtained fairly accurate results by using organic alkaloids as precipitants; but this method may be objectionable on account of the expense. A good practical method of determining tannin in the various materials named remains, in my opinion, still a desideratum.

Mr. Hunt: In Procter's process the filtrate from the tannin and gelatin is nearly colourless. Alkaloids could not be used, as the results are too low. The precipitate of the alkaloids is slightly soluble, Neubauer having shown that even when excess of cinchonine was added the filtrate contained tannin.

The Chairman: Does your method give the results?

Mr. Hunt: The "permanganate value" of the tannin in each material is different. For instance, the tannin of gallnuts is quite different, as regards its action on permanganate, to that of oakbark. The tannin of sumach most nearly resembles gallo-tannin.

The Chairman: How can you compare them?

Mr. Hunt: I always give my results in terms of oxalic acid, as recommended by Procter. It is useless to try to compare the relative values of different tannin materials. It is only possible with certainty to compare different samples of the same material.

The Chairman: That seems to indicate an acknowledgment that the method does not apply to different materials.

Mr. Hunt: There is no method which does that.

Mr. Siebold: It is certain that all these methods estimate more than the tannin present, and that the results are therefore too high. I cannot endorse the unfavourable opinion expressed by Mr. Hunt relative to the alkaloid processes, and am inclined to think that the lower numbers obtained by them are less due to the solubility of the precipitates than to the greater freedom of the latter from colouring matters. For the purposes of the tanner, the gelatin process, as well as some of the other methods in common use, may perhaps be regarded as more satisfactory than for the purposes of the dyer and printer, inasmuch as the colouring matter which renders the tannin estimation too high passes into the leather along with the tannin. In fact a certain body of colour is desired by the tanner, and so long as this is not excessive and not of an unsuitable shade, it is a valuable constituent of the materials employed in tannin. It ought to be well understood that none of the analytical methods alluded to by Mr. Hunt will give the actual proportion of pure tannin; and that for this reason dyeing experiments will often give more valuable results than a chemical analysis.

Mr. Hunt: By my method there is less "extractive" precipitated than by Procter's. In Procter's method the complete saturation of the liquid with salt undoubtedly precipitates a considerable amount of "extractive" along with the tannin. In the method given to-night, as the tannin liquid is not saturated with salt, less "extractive" is precipitated with the tannin, though, of course, I cannot say for certain that tannin only is precipitated. It is unfortunate that I have been unable to give you in a large diagram the full list of analyses, which would, I think, have shown you the difference between the two methods. If there is no salt or acid added it would be almost impossible to filter the solution.

Mr. Siebold: The extent to which these colouring matters and vegetable extractives impair the result is much larger than is generally supposed. In some instances in which I ought to have found about 10 per cent. of tannin, the analysis showed double that amount and more, which shows at once how utterly unreliable these tests are when applied to such substances as I have before named.

Mr. Hunt: As regards the precipitation of colouring matters, do you use alum with the gelatin, and did you prove that alum had no part in the precipitation of the colouring matter?

Mr. Siebold: I feel satisfied that the precipitation of colouring matters by gelatin, to which I have repeatedly alluded, is not due to the small proportion of alum used in my experiments, but would occur equally just the same in its absence.

Mr. Sansone: I beg to endorse Mr. Siebold's remarks with regard to the ordinary methods of estimation of tannin not being reliable. I always use comparative methods, which are the only ones to be relied upon. First of all I ask myself what is the tannin to be used for? In the case of sumach, we know it is used by dyers, and we must have regard to the amount of work to be done. Suppose we take some cotton and prepare it with a solution of acetate of iron; we dry it and expose it to the air, and then by passing it through a whiting bath we complete the fixation of the oxide of iron on the fibre. Now, if we take a weighed quantity of this cotton and dye it in a bath containing tannic acid, we form a grey colour on the fibre. If we take two or three different samples which are treated in a similar manner, we can judge by the depth of shade which of the samples is the strongest; and if we take the different samples in relation to their price, we have at once a comparative method—that is, the sample which will give the deepest shade on the cotton prepared with iron will be the strongest. There is another plan which could be followed, and which also gives good results. If cotton be mordanted with different samples of tannic acid, which are to be tested and left over night in the bath, then next morning passed through a bath of tartar emetic and washing, we have here several patterns which can give us an indication of the strength of the tannic acid, especially if the quantity of the tannic acid had been calculated in proportion to the price. If we dye all these patterns in any aniline colour, say magenta or methyl-green, the pattern which had been prepared with the strongest tannic acid will give the deeper shade, and therefore in this case also you have a comparative method, and this method can be made even more exact by soaping these dyed patterns, and the colour which remains on the fibre will give an indication of the strength of the tannic acid employed.

Mr. Grimshaw: How would Mr. Sansone arrive at the value of a material used for tanning leather by the comparative process he mentions? Such a method as he alludes to would no doubt be a good criterion of the value as a dye, but is not applicable to its use for tanning, where many different constituents are absorbed by the leather or skin, and comparative "tanning" would be a very different thing from comparative "dyeing."

Mr. Sansone: The method I mentioned is only valuable to dyers of cotton; but for leather I should think a comparative method might also be tried.

NOTE ON THE DESTRUCTION OF TANNIN BY BOILING SOLUTIONS OF GAMBIER.

BY BERTRAM HUNT.

Gambier, as you are doubtless aware, is an extract from the plant *Uncaria Gambir*, and is imported in large quantities from Singapore. It occurs in the market in two forms—"bale" and "cube"—of which the latter is the more valuable, being drier than the "bale," and offering less opportunity for fraudulent adulteration. It is used largely in tanning, the strong liquor made by dissolving about four pounds per gallon in boiling water being added in suitable proportions to the tan liquor in the pits. The usual method of dissolving gambier is to put it in a tank with the requisite quantity of water, and boil up with naked steam till the whole is melted. The solution has to be used while hot, as if allowed to cool it "sets," and becomes semi-solid. During the boiling the colour of the liquor becomes very dark, and there is an evident loss of tannin. It occurred to me that it would be of interest to estimate the amount of this loss, and I have done so with the following results. 400grm. of cube gambier were placed in a flask, with a litre of water. The flask was then connected to an inverted condenser, and the contents heated to boiling and boiled gently for 20 minutes. 400grm. of the same gambier were now placed in a stoppered test-mixer, with a litre of water heated to 60° C., and the test-mixer shaken till all the gambier was dissolved. The two solutions were allowed to stand over night, and the clear liquor then analysed, with the following results:—

Water at 60° C.		
Tannin, as oxalic acid	15·960grm.	per 100cc.
Other matters	4·200grm.	,,
Total Extract	21·200grm.	,,
Boiled.		
Tannin, as oxalic acid	15·524grm.	per 100cc.
Other matters	4·536grm.	,,
Total Extract	21·560grm.	,,

The experiment was repeated under the same conditions, with the exception that the boiling in the one case was continued for 40 minutes. In this experiment 0·504grm. tannin per 100cc. were destroyed. These results show that when working under conditions more favourable for the preservation of tannin than are the case in practice, there is a considerable loss of tannin. Without taking into consideration the loss incurred owing to the darkening of the colour (which, with tanners, is an important point), if the gambier liquor is made by dissolving four pounds in one gallon of water, and gambier containing 50% tannin at 26s. per cwt. be taken, it will be found on calculating that the value of the tannin destroyed comes to a fraction over £1 for every 1000 gallons of liquor made.

NOTES ON THE TESTING OF DYEWOOD EXTRACTS, AND SIMILAR PREPARATIONS.

BY L. SIEBOLD.

Mr. Siebold stated that it had been, and was still his intention to deal with this subject in a more complete manner at an early meeting next session.

The various published methods for the analysis of dyewood extracts were commented unfavourably upon, their being regarded as very unsatisfactory and affording no trustworthy indication of their value to the dyer and printer. Chemical knowledge of these preparations is still in a very imperfect state ; and as long as this is the case the essayist prefers to rely for this purpose on carefully conducted dyeing experiments rather than on chemical analyses. In the majority of cases wool dyeing is much to be preferred to cotton dyeing for these tests, inasmuch as the former renders a complete exhaustion of the dye-bath possible, while the latter does not, and even where the extract under examination is intended for cotton dyeing he is still decidedly of opinion that the testing should be done by means of wool dyeing, which is in every way better calculated to show the actual strength of the preparation to be tested. Experimental cotton dyeing is in most cases less a criterion of the actual strength and money value of an extract, than of the more or less developed or oxidised condition in which the colouring matter exists in it, and gives the experimentor a better idea of the speed of dyeing than of the real extent of the dyeing power of the preparation. In many cases its indications are entirely deceptive. A number of instances in support of this view was mentioned by the essayist. He laid great stress on the necessity of conducting these dyeing trials with a degree of care and accuracy equal to that required in chemical analysis, and showed that it is impossible to distinguish with certainty between one extract and one but slightly inferior to it, unless the greatest care is given to the weighing of the extracts, the measuring of the solvents, and to the perfect equality of temperature, and other conditions during the dyeing process. The mordanting, too, should be conducted with the same degree of exactness. Mr. Siebold explained a variety of circumstances likely to lead to erroneous results, and the best conditions for ensuring success in these tests. All the details respecting these will be published in the more exhaustive paper promised by him on this subject.

DISCUSSION.

The CHAIRMAN, in proposing a vote of thanks, said : It seems to me that communications similar to those given by Mr. Hunt and Mr. Siebold are particularly valuable to the Society in showing how necessary it is—not less necessary in the workshop, the dye house, and the colour shop than in the laboratory—in all cases to adopt a system of scientific accuracy in order to bring our industries forward.

Mr. W. THOMSON, in seconding the vote of thanks, said : I understood Mr. Siebold to say that he added 3 per cent. of chromate of potash. It has always puzzled me to know how it is that if you use double the quantity of water you get the same results ?

Mr. SIEBOLD : It is practically immaterial whether the quantity of water used in mordanting pieces of wool with bichromate of potash is exactly the same in each case or not. What is important is the ratio of the bichromate to the weight of the wool. If I were to mordant a piece weighing 10grms. in a litre of water containing 0·3grm. of bichromate, the result would not materially differ from that obtained by mordanting three such pieces together in the same quantity (1 litre) of water containing three times that proportion (0·9grm.) of potassium bichromate. The main point in testing a dyewood extract by wool dyeing, is the presence in the cloth of a sufficient amount of mordant to fix the entire quantity of colouring matter used in the experiment, or, in other words, to completely exhaust the dyebath. In the case of logwood extract, this end is completely attained by boiling such a piece of well-mordanted wool, in the case of logwood or fustic extract, for $1\frac{1}{2}$ hours in a litre of solution containing not more than 0·6grm. of the extract to be examined.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

Total number of Members of the Section—193.

Notices of papers and communications for the Meetings to be sent to the Local Secretary.

May 5. 1. "Wood Naphtha," by Mr. C. A. Fawsitt; 2. "Notes on Destructive Distillation," by Professor Mills.

ADDENDUM.—Mr. COLEMAN desires to state that upon coming to complete his paper on an "Improved Air Thermometer," preliminary notice of which was communicated to the Society on the 6th of January, 1885, he finds he ought to have stated that the lengths of degrees being doubled when the absolute temperature of the air in the bulb is diminished one half, is only true when the expelled air is measured at the reduced temperature, for when it is measured at the initial temperature the degree will be quadrupled in length, as the *density* of the air at the reduced temperature will be double of what it was at the commencement.

Journal and Patent Literature.

II.—FUEL, GAS, AND LIGHT.

The Illuminating Power of Hydrocarbons. I. Ethane and Propane. Percy F. Frankland, Ph.D., B.Sc. Abstr. Proc. Chem. Soc. 1884-5 [4], 31.

IN continuing his researches on illuminating gas, the author has determined the illuminating powers of ethane

and propane. The gases were prepared by the action of the zinc-copper couple on ethyl and isopropyl iodides respectively, and then subjected to purification by passing them through bromine. The illuminating power of ethane, when consumed from a "referee's burner," at the rate of 5 cubic feet per hour, was found to be 34·8 candles, and that of propane 53·3 candles. The illuminating power of ethane is thus almost exactly half that of ethylene (68·5 candles), whilst that of propane is 1·5 times as great as that of ethane. From these results it appears that in the paraffin series of hydrocarbons, excluding the first member, methane, the illuminating power is directly proportional to the number of carbon atoms in the molecule.—W. S.

Combustion in Dried Gases. By H. Brereton Baker, B.A. Abstr. Proc. Chem. Soc. 1884-5 [5], 37.

Led by Dr. Dixon's experiments, the author has investigated the question whether moisture is necessary for the combustion of carbon and phosphorus in oxygen. The phosphorus used (commercial amorphous phosphorus) had been washed with water and dried at 100° in a current of carbon dioxide previously passed through two wash-bottles of sulphuric acid; it was then heated in a Sprengel vacuum, at 150-160°. The carbon (finely powdered charcoal) had been heated to bright redness in a current of dried chlorine for three hours; the tube containing it was then transferred to an air-bath and heated at 200° while a current of dried air was passed through it. Portions (0·5—1grm.) were sealed up in bent hard glass tubes along with phosphoric oxide, the tube being filled with oxygen prior to sealing; to free the glass from adhering moisture, the ends of the tubes containing the carbon or phosphorus were heated in an air-bath at 130-150°, the other ends being kept cool.

	Wet.	Dried 1 Week.	Wet.	Dried 2 Weeks.	Wet.	Dried 4 Weeks.	Wet.	Dried 8 Weeks.	Wet.	Dried 12 Weeks.	Wet.	Dried 16 Weeks.
CO_2	50·1	15·4	51·0	19·0	45·3	11·1	23·3	12·5	58·8	15·8	52·4	17·8
CO	22·2	20·6	31·2	11·8	32·5	27·8	60·0	27·5	23·2	24·2	25·2	16·5
O_2	—	41·3	—	46·1	—	28·2	—	39·0	—	33·3	—	45·0
N_2	27·6	22·6	17·7	20·1	22·1	29·8	16·6	21·0	17·9	26·6	22·3	20·6

After about eight days, the tube containing phosphorus and dried oxygen, and another similar tube with phosphorus in oxygen saturated with water, were supported at the same height above the flame of an Argand burner: the phosphorus in the wet gas soon took fire, but that in the dried gas slowly distilled and formed a red and yellow deposit on the cooler part of the tube. A similar pair of tubes containing carbon was placed over the large flame of a Bunsen burner: the moist carbon burnt with bright scintillating flashes, but no apparent combustion took place in the tube containing dried gas, though it was heated to bright redness for several minutes. A series of such experiments with carbon were then made, in which the drying extended over various periods, the gaseous contents of the tubes being analysed after the tubes were heated. The results obtained clearly show that the burning of carbon is much retarded by drying the oxygen to the extent which is possible with the arrangement adopted by the author. Other forms of the experiment were described, which led to similar results. The author successfully made an experiment before the Chemical Society with two tubes, the one containing dried, the other undried, oxygen and carbon.—W. S.

The Explosion of Coal-dust. A. Gurlt. Berg-u. Hüttenmannische Zeitung, 1885, No. 3, p. 21.

The author describes experiments which show that coal-dust can give rise, like marsh gas, to dangerous explosions.—A. G. G.

Improvements in Apparatus for Purifying Coal-gas. W. T. Walker. Eng. Pat. 2279, January 28, 1884.

This specification describes a modification in the construction of Walker's scrubber. The lower portion of the scrubber is filled with thin boards set on edge, each layer crossing the next; the upper portion is filled with coke. The topmost portion of the scrubber is made of an enlarged diameter, and an annular seal cup is formed inside the enlarged part to act as a seal in which the inverted edge of a perforated dashplate rotates above the coke. The perforated dashplate being of greater diameter than the main body of the scrubber, the water is distributed over the entire area of the scrubber. Above the dashplate are the water-distributing arms, which will be rotated in the direction opposite to that of the dashplate. The outlet for the gases from the scrubber is placed above the dashplate to compel them to pass through the wet perforations in the dashplate. The lowermost portion of the scrubber is arranged as a washer to remove the tar, of which, however, no description is given.—C. C.

Improvements in Apparatus for use in the Manufacture of Gas. B. Midgley and Wm. Nunwick. Eng. Pat. 2485, January 31, 1884.

Describes an apparatus designed for the purification of coal-gas from tar and ammonia. In a cylinder placed horizontally is arranged another cylinder. Both cylinders are closed at each end by plates, which are common to both of them. The space within the inner cylinder forms a scrubber and washer, and the space between the inner and outer cylinder a condenser. Within the inner cylinder is a wrought-iron shaft, one end of which is supported in a socket, the other end passes through a stuffing box to receive the driving gear. Fixed alternately to this shaft and to the inner circumference of the inner cylinder, are circular iron plates having perforations. The perforations of the fixed plates are near their centres, the perforations of the revolving plates are around the outer edge. At each side of the revolving plates are secured circular brushes, filling up the space between the fixed plates and the revolving plates, so as to prevent any gas passing otherwise than through the brushes. Tar and liquor run from end to end of the cylinder, either continuously or through separate compartments. The inlet and outlet of the gas are in the end plates. The space between the inner and outer cylinder forms a condenser, and water is supplied to it in regulated quantities. The gas passing through the perforations in the plates, and through the wetted brushes, is freed from ammonia and other impurities.—C. C.

Method of and Means or Apparatus for Generating Gas from Hydrocarbons. A. J. Boult. Eng. Pat. 5794, April 1, 1884.

This specification describes an arrangement for vaporising hydrocarbon oils for the purpose of using the vapour as fuel in the manufacture of iron, but it is too replete with minor details to allow of abstraction. The gist of it is apparently that the hydrocarbon oil is injected by means of superheated steam into the annular space formed by two pots of different diameters, placed one inside the other. The outer pot is heated by fire. The mixture of steam and hydrocarbon vapour passes from thence into a mixing chamber, and from it to the space where combustion takes place.—C. C.

Improvements in the Construction of Gas Retorts. G. K. Harrison, Stourbridge. Eng. Pat. 5835, January 2, 1885.

THE retorts are made circumferentially in four segments, a number of which, breaking joint, are connected together to form the length of the retort. In oval or round retorts the top and bottom segments are interchangeable, as are also the side segments. The segments have rabbeted edges, and are made to correspond with one another. Of the four segments forming the mouth of the retort, the top and bottom pieces are not only rabbeted at their edges, but also have indents formed therein, while the two side pieces are provided with projections fitting into the said indents, so that when the mouthpiece is bolted on the tightening of the screws draws all close together, and prevents the too common occurrence of the retort cracking at or about the neck.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On the Presence of an Isocyanide (Carbylamine) in the "Light Stuff" from Commercial Benzene. E. Noelting. Bulletin de la Soc. Ind. de Mulhouse, October, 1884, p. 461.

THE experiments resulting in the detection of the above compound were undertaken at the request of Dr. Werner, who had performed the autopsy of a workman, who died suddenly whilst engaged in his duties at an india-rubber works at Thann, where the "light stuff" from naphtha was employed in the manufacture. When ninety per cent. and fifty per cent. benzene are rectified in aniline works, a certain quantity of a more volatile liquid than benzene distils over first, and this is technically termed "light stuff." This product has been studied at different times. Helbing found, besides a certain amount of benzene, carbon bisulphide, crotonylene, amylene, and hexylene. Witt further detected ethyl alcohol; and, finally, Vincent and Delachanal obtained, in addition to these, considerable quantities of acetonitrile and methyl cyanide. The author, who had on various occasions some of this light product in his possession, has often observed the strong odour of isocyanides. The probability of one or more of this class of bodies being present seemed to gain force from the fact that on the addition of an acid the odour in question disappeared, and was replaced by that of carbon bisulphide, alcohol, hydrocarbons, and acetonitrile. By evaporating the hydrochloric acid solution, sal-ammoniac and a small quantity of the hydrochloride of a primary amine was obtained. The proportion of isonitriles contained in the "light stuff" is very small, but the odour is very penetrating and characteristic, and its poisonous properties exceedingly energetic. From the boiling point of the "light stuff" it can only contain methyl or ethyl isocyanide, the former boiling at 59·6°, the latter at 78·1°. The "light stuff" from benzene has no practical use. The benzene is extracted as far as possible by distillation. Sometimes it is employed for dissolving caoutchouc; but for this purpose solvent naphtha, which distils at 120-150° (a mixture of a little toluene, xylene, cumene, and hydrocarbons of the fatty series, and the oils of turpentine), is generally preferred. —J. B. C.

Synthesis of Thiophen. Victor Meyer. Ber. 18, 217.

A SHORT note of the results of experiments made with a view to demonstrate the constitution of thiophen by synthetical reactions. Thiophen was formed, but in too small quantities to afford support to any proposed structural formula. By passing ethylene or petroleum spirit vapours over heated pyrites, or ethyl sulphide alone through a red-hot tube, or by heating crotonic or butyric acid with sulphide of phosphorus, thiophen was in each case obtained, whilst, according to expectation, no thiophen was obtained by the action of phosphorus sulphide on isobutyric acid.—G. H. B.

Synthesis of Thiophen and Pyrroline Derivatives. C. Paal. Ber. 18, 367.

THE author has previously shown that acetophenoneacetone by the action of dehydrating agents gives a furfurane derivative, and supposes that the diketone group $-CO-\overset{|}{C}H-\overset{|}{C}H-CO-$ in the reaction changes into the unstable form $-\underset{OH}{\overset{|}{C}}-\overset{|}{C}=\overset{|}{C}-\underset{OH}{\overset{|}{C}}-$ and from this the constituents of water are eliminated. From the analogy existing between furfurane, thiophen, and pyrroline, both in their method of preparation and properties, it seemed possible that by the action of H_2S a thiophene-, of ammonia, a corresponding pyrroline-derivative, might be prepared. This supposition has been confirmed.

Phenylmethylthiophen is formed by the action of P_2S_5 on acetophenoneacetone at a temperature of 120-130°. The crystalline body obtained has the formula $C_{11}H_{10}S$, and gives the characteristic blue colour with isatin and sulphuric acid. By heating acetophenoneacetone with alcoholic ammonia to 150° a corresponding pyrroline-derivative is obtained, having the formula $C_{11}H_{11}N$, and which is therefore phenylmethylpyrroline.—J. B. C.

On a Simple Method of Preparation of Thiotolen and Thioxen. K. E. Schulze. Ber. 17, 2852.

THE process described by V. Meyer for the preparation of thiophen is inconvenient owing to the large quantities of liquid which must be operated on, and to the loss by the destructive distillation of the ammonium salt of the sulphonic acid. The author attempted to obtain thiotolen and thioxen directly by the distillation of the impure sulphonic acids with aqueous vapour. In the first experiment with the xylene acid steam was passed rapidly into the acid heated to 100°, but the yield was small, and large quantities of sulphur dioxide were evolved. A much better result was obtained by mixing the acid with one fifth of its weight of boiling water, and passing a slow current of steam into the solution. The yield of oil thus rose from two to nine per cent. The product boiled, for the most part, between 135° and 138°, and the distillate contained 44·4 per cent. of thioxen. The acid contained xylene mechanically mixed with it, and this would account for twenty per cent. of the fractionated oil. The results with the toluene acid were not so satisfactory, the decomposition being greater. A better yield was again obtained by the addition of water to the impure acid. Only about four per cent. of oil was obtained, and it did not boil nearly so constantly as the crude thioxen. The product after rectification boiled between 111° and 113°, and contained 22·3 per cent. of thiotolen. A portion boiling at about 80° contained thiophen, and the author hopes to obtain this substance by the same method.—S. Y.

Thiophen from Mucic Acid. C. Paal and J. Tafel. Ber. 18, 456.

PAAL has shown (*Ber.* 18, 367) that acetophenoneacetone ($C_6H_5.CO.CH_2.CH_2.CO.CH_3$), according as it is treated with P_2O_5 or P_2S_5, yields a furfurane derivative (phenyl-methyl-furfurane), or a thiophen derivative (phenyl-methyl-thiophen). As now mucic acid also gives a furfuran derivative by splitting off water (pyromucic acid or furfurane-carboxylic acid), it seemed probable that under the influence of H_2S it would give thiophen carboxylic acid, and this proved to be the case.

Thiophen-α-carboxylic Acid.—A mixture of mucic acid and barium sulphide was heated to 200-210° in scaled tubes, the product boiled with water and filtered; the filtrate was acidified and extracted with ether. After purification the thiophenic acid formed long fine needles melting at 126-127°. Yield, 10 to 12 per cent. of the theoretical.

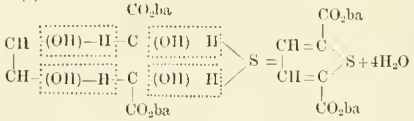
Reactions.—It gives the blue colouration with isatin and sulphuric acid. With Fe_2Cl_6 it produces a citron-yellow precipitate.

Salts.—$(C_6H_3SO_2)_2Ca,3H_2O$—easily soluble needles. $(C_6H_3SO_2)Ag$—difficultly soluble crystals.

The formation of thiophen-carboxylic acid from mucic acid probably takes place in the following stages:—

(1) Mucic acid and BaS give barium mucate and H_2S.

(2)



(3) The thiophen-dicarboxylic acid then splits off CO_2, forming thiophenemonocarboxylic acid.

Thiophen.—By distilling the thiophenic acid with lime a distillate was obtained, which, on purification, gave pure thiophen, boiling at 83-84° C. (731mm.). The yield was 40 per cent. of the theoretical. The thiophen thus obtained was in every respect identical with the coal-tar thiophen.—A. G. G.

Preparation of Thiophen. K. E. Schulze. Ber. 18, 497.

THE author proposes the following simple method for the preparation of thiophen. Strong sulphuric acid, which has been shaken for three or four hours with 20 times its weight of benzene (of constant boiling point), is at once diluted with two or three times its volume of water and distilled with steam. The thiophen separated from the distillate (about three per cent. by volume of the acid used) is nearly pure, since the sulphonic acids of the benzene hydrocarbons are not decomposed in such a dilute solution; 96 per cent. of the product distilled between 84° and 85° C. The specific gravity at 15° C. was 1·1.—A. G. G.

Thiophen. V. Meyer and O. Stadeler. Ber. 17, 2778.

IT is a well-known fact that commercial dinitrobenzene dissolved in alcohol gives a light magenta colouration on the addition of a drop of potash solution. The following experiments have fully explained the cause. The preparation of the nitro derivatives of thiophen made it appear probable that the corresponding amido compound analogous to aniline could be obtained. Every attempt in this direction with any of the ordinary reducing agents failed. A violent reaction occurs, the substance being completely decomposed with evolution of sulphuretted hydrogen. The nitro derivatives of thiophen, however, resemble the amines of the benzene series in their property of forming colouring matters, a fact which at first sight might appear remarkable. When, however, it is considered how much more marked are the colour-forming properties of thiophen and its homologues, compared with hydrocarbons of the benzene series, it is not surprising that the nitro derivatives should have a similar tendency. Mononitrothiophen turns red on exposure to light; boiled with aqueous alkali it dissolves, forming a deep brown solution. The colouration produced by reduction of the sulphonic acid is particularly striking. Mononitrothiophen dissolves n fuming sulphuric acid, and forms a well-defined sulphonic acid, the potassium and ammonium salts of which readily crystallise. On reduction of the nitro-sulphonic acid with ammonium sulphide a magenta-coloured solution first forms, the colour gradually vanishing on further reduction. The reaction is more striking when bibulous paper moistened with the sulphonic acid is exposed to the vapours of ammonium sulphide. The paper is coloured deep red. The reaction with dinitro-thiophen is still more intense. This substance is dissolved in alcohol, and on the addition of one drop (not more) of aqueous potash a deep red solution is produced, which in thin layers has a violet tint. An excess of alkali or acid destroys the colour; but it is restored by carefully neutralising, the colour being due to the formation of the potassium salt. By precipitation with ether a violet-red resin is left, which dissolves in alcohol without change of colour. The corresponding silver salt is a reddish-brown explosive powder. The above reaction of dinitro-thiophen with potash explains then the phenomenon observed by adding alkali to dinitro-benzene. A comparison of the colours prepared from both sources leaves little doubt as to its true nature, which is further confirmed by the fact that dinitro-benzene prepared from benzene free from thiophen gives no colouration whatever. Commercial mononitro-benzene gives the same reaction as the dinitro compound, that free from thiophene remains colourless. This distinction can therefore serve as a test for thiophen in the benzene, from which the nitro compounds have been prepared.—J. B. C.

Perchlorophenol from Perchlorobenzene. A. Weber and N. Wolff. Ber. 18, 335.

PERCHLOROBENZENE (C_6Cl_6) heated to a high temperature with caustic soda yields perchlorophenol. Commercial glycerine is heated to 250° in a flask, caustic soda, and then perchlorobenzene, gradually added. The mixture is kept at a temperature of 250-280° for half-an-hour, and repeatedly shaken. On cooling, water is added, and the aqueous solution filtered and saturated with HCl. The precipitate which forms is recrystallised from benzene. Perchlorophenol has the formula $C_6Cl_5.OH$, melts at 187-188°, and is identical with that obtained by chlorinating phenol.—J. B. C.

The Reverse Action of Friedel and Craft's Synthetical Method for Preparing the Hydrocarbons. O. Jacobsen. Ber. 18, 338.

BY the action of aluminium chloride and methyl chloride on pure mesitylene, in addition to isodurene, a quantity of durene was formed. It appeared therefore that either mesitylene gave metaxylene, then pseudocumene and durene, or that penta- and hexamethylbenzene were first produced, and then durene, by elimination of the methyl groups. In either case the formation of durene must be due to the reverse action of Friedel and Craft's synthetical method. Experiments confirmed this supposition. The hydrocarbons were heated with Al_2Cl_6, in some cases alone, and in others in a current of HCl.

Hexamethylbenzene was heated with half its weight of Al_2Cl_6 to 200°, the chief products being pentamethylbenzene, durene, and isodurene and small quantities of benzene, toluene, xylene, and trimethylbenzene.

The elimination of the methyl groups is more complete if the above experiment be conducted in a current of HCl.

Pentamethylbenzene and Durene gave similar results to those of the hexamethyl derivative, durene and isodurene being formed, also a certain quantity of hexamethylbenzene.

Pseudocumene treated in the same way gave benzene, toluene, xylene, durene, isodurene, and traces of pentamethylbenzene.

Mesitylene heated to 150-160° with Al_2Cl_6 in a current of HCl, produced traces of the lower methyl benzenes, also pseudocumene, isodurene, and durene. The chief portion, however, consisted of unaltered mesitylene.

From metaxylene the higher methylated hydrocarbons were principally obtained. The results of the experiments may be stated shortly as follows:—

By the action of dry HCl on methyl benzenes in presence of Al_2Cl_6 the methyl group may be eliminated, and the hydrocarbons reduced to their lowest homologues. In every reaction the methyl chloride formed acts upon the hydrocarbons, producing the higher homologues. These higher methylated hydrocarbons can then again undergo decomposition, so that by this reaction a process of synthesis and decomposition is going forward until a state of equilibrium is attained. Usually the elimination of the methyl group by HCl is facilitated by a high temperature, its substitution by a lower temperature.—J. B. C.

The Carbonisation of Wood. Hugo Blank. Dingl. Polyt. Journ. 255 [10], 435.

Wilh. Söltz, of Schemnitz, has recorded his observations during a visit to the works where wood is carbonised in Trzynietz (Austrian Silesia), which are all the more interesting because the arrangements show many differences from those existing in English works, and especially in the means adopted for working up all by-products.

The plant arrangement shown in Figs. 1 to 6 is designed for an annual consumption of 18,000 cubic meters of wood. This wood is carbonised in 22 cylinders or retorts R, set up in a line and enclosed in brickwork. These retorts are of wrought iron, and measure $2\frac{1}{2}$ meters in length, and 1 meter in diameter. Each retort has a cast-iron door, and a wrought-iron false bottom, supported by a bar with an ear or loop at its extremity, so that by attaching the chain of a locomotive windlass *a* (Fig. 5) to it, the false bottom can be drawn out, and thus the charcoal can be emptied. It falls into sheet-iron boxes placed on tram-wagons. The false bottom is furnished with holes 2 to 3cm. wide, so that the gaseous distillation-products can more easily be drawn off. The retorts are surrounded by brickwork, and the fire circulates around them, afterwards passing down the flue *b* (Fig. 5) into the main flue *c*, and then to the chimney. Fig. 6 shows how that each pair of retorts is combined with one and the same condenser K, in which the gases pass through a pipe *l* made fast in the hindmost door of the retort.

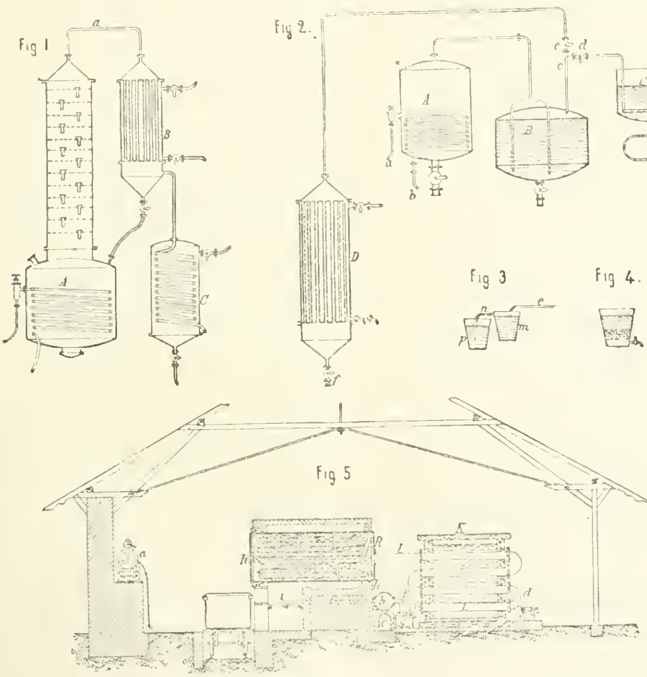
The distillation products flow through the small side-tubes *d* into the common trough or gutter *e*, whilst the uncondensed gases pass through *f* into a common gas-holder *g*, and from this through 2 or 3 pipes into the main-pipe *h*, from which the gases pass through the small flues *i* under the fire-place, but so as eventually to enter amongst the fuel, and thus aid in heating the ovens.

The retorts only last, it is stated, from 9 to 18 months, whereas in England the wrought-iron cylinders are good for 6 years, and cast-iron ones for 15 years.

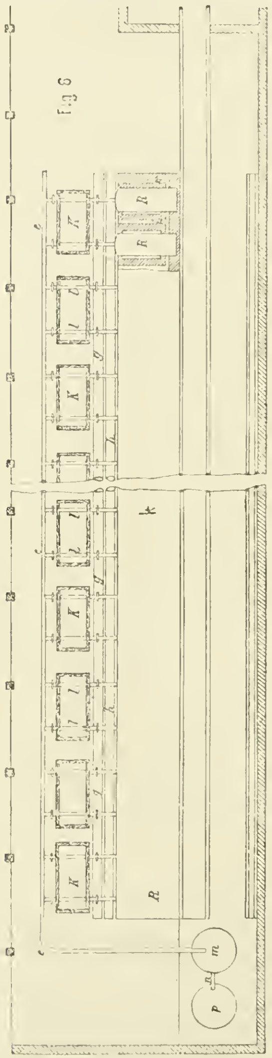
For the charring of 250kilos. of wood, 100kilos. of coal were necessary, the temperature is maintained at from 350° to 400°, and the carbonisation period covers from 8 to 12 hours.

As soon as the glowing charcoal has fallen into the sheet-iron box, the latter is closed with an iron lid, the luting made good with mortar, and the box, together with the tram-wagon, is let stand 24 hours in the cooling-chamber. The condensed products of distillation pass from the trough *e* (Fig. 3) into the vat *m*, and from this trough the overflow pipe *n* into the vat *p*, standing deeper still. In both these vats, the greater part of the tar will have already settled down; in order that this may take place more completely, the supernatant liquid is drawn off by means of a steam pump into a cistern set on a higher level, from which it is run off, just as before, into a second, and finally into a third vat (Fig. 4), which, however, contains in the middle of it a double false bottom perforated with narrow holes, and filled with good cokes.

For obtaining acetic acid, acetone, allyl- and methyl-alcohols, the watery liquid, completely freed from tar, is brought into a copper still A (Fig. 2), holding from 20 to 30 hectolitres, and heated there with a steam coil through which steam at from 3 to 4 atmospheres' pressure enters at *a* and escapes at *b*. The copper pipe from the still-head passes into an air-tight copper receiver B, where it branches off into two parts, furnished with small holes. From this vessel or boiler a copper pipe passes, branching off at right angles at *c*; the one branch passes into the



open copper-boiler C, upon the bottom of which it ends in a U-shaped tube perforated with small holes; the second branch passes into the copper tubular condenser D. The vessels B and C are filled with milk of lime to fix the acetic acid. As soon as the liquid in A evaporates, the escaping acetic acid is retained by the milk of lime in B, and calcium acetate is formed; the



other products of distillation on closing the cock *d* and opening the cock *e* pass into the condenser D, from whence they are run off at *f*, completely condensed; the result is, besides water, acetone, allyl- and methyl-alcohols. After evaporating off the first 10 per cent. of the contents of A, all the volatile products named are driven off completely; it is then necessary, when all the milk of lime in B is already combined with acetic acid, and still acetic acid vapours are perceptible, to absorb these vapours completely in the vessel C, effected by closing the cock *e* and opening *d*. The solution of calcium acetate formed in B and C is now concentrated in iron evaporating vessels over open fires, or in lead-lined wooden evaporating pans, arranged in step fashion, one above the other, and heated with steam coils, till pellicles of salt form on the surface. In order to free the salt thus separated from adhering tarry matters, it is cautiously and gently ignited. If completely pure calcium acetate is to be obtained, then the calcined crude salt is purified by solution and crystallisation. If acetic acid is to be prepared, the calcium acetate is decomposed with hydrochloric acid (100 parts of the salt require 90 to 95 parts of hydrochloric acid of 1·16 sp. gr.), and the mixture distilled in copper vessels; the condenser is best made of tin. For the preparation of chemically pure acetic acid, sodium acetate is taken.

The separation of the acetone, allyl- and methyl-alcohol from the water, and from each other, is effected by means of fractional distillation, which in Trzynietz was performed in an arrangement like a Savalle's column-apparatus (Fig. 1). The liquid to be distilled is placed in the boiler or still A, heated with steam, and connected above with a column separated into several compartments by a number of copper-sieves; the ascending vapours pass through the sieves, and separate the water, which, condensing, falls on the sieves and forms a layer of a certain height. Whilst the vapours must pass through this layer of water, they become constantly drier, until they pass through the pipe *a* into the tubular condenser (dephlegmator) B. The liquid condensed here, and still containing water, is returned to A, whilst the still gaseous alcoholic constituents condense later on in the dephlegmator C, and according to the different periods of their boiling-points, first acetone, then methyl-alcohol, and, lastly, allyl-alcohol, flow out.

This Trzynietz Works is an example of the advantage of charring in retorts, and of the profit to be realised under circumstances in which the by-products can be recovered and utilised. With the ever-increasing scarcity of cheap wood-charcoal, this process in the region of great forests and rich iron-ore deposits would be of great influence in increasing profits, or making competition possible in many works. It remains yet to be ascertained by practical experiments, how far the wood charcoal obtained in retorts as described can replace that obtained in the meilers or mounds; as a contribution to such experience, experiments with Trzynietz charcoal in the Erzherzog Abrecht Works in the Bindt (Zips) have borne favourable testimony in the direction of such advantageous replacement.

—W. S.

The Action of Chloropicrin and Chloroform on Toluene in presence of Chloride of Alumium. K. Elbs and O. Wittich. Ber. 18, 347.

The method is the same as that adopted for the preparation of triphenylmethane, the mixture of chloropicrin and toluene being, however, diluted with an equal volume of CS_2. The product was distilled with zinc dust, and an oil obtained distilling at 270-290° C., and also a portion distilling above 360°. The former was found to be ditolylmethane, the latter tritolylmethane. In all probability the tritolylmethane consists of several isomers, as it could not be crystallised. By repeating Schwarz's experiments (*Ber.* 14, 1526)—*i.e.*, substituting chloroform for chloropicrin—the authors obtained small quantities of di- and tritolylmethane and a substance identical with that described by Schwarz as tetratolylethane, but which bears a strong analogy in its chemical properties to an anthracene derivative. The results of the analysis would also agree with a compound of the formula of dimethylanthracene. The

reaction which occurs can be represented by the following equation:—

$$2CHCl_3 + 3C_6H_5.CH_3 = CH_3C_6H_3 \langle \begin{matrix} CH \\ | \\ CH \end{matrix} \rangle C_6H_3.CH_3 + 5HCl + C_6H_4ClCH_3.$$

The following proportions of the different substances employed are found to give the best yield of dimethylanthracene: 3 parts of toluene, 3 parts of CS_2, 1 part of $CHCl_3$, and 2 parts of $AlCl_3$. The dimethylanthracene obtained in this way melts at 215-216°, and is therefore not identical with either of the two already known.

—J. B. C.

Fluorene. Dr. W. R. Hodgkinson. Abstr. Proc. Chem. Soc. 1884-85 [5], 36.

In two previous notes to the Chemical Society, the author has remarked upon, and given examples of, the facility with which fluorene and its derivatives condense to a double molecule, owing to the presence of the CH_2 group. This action takes place when fluorene is heated to a high temperature alone or in contact with even very gentle oxidising agents. In a previous note two isomeric difluorenes were described, which were obtained from the red body produced when fluorene is passed over red-hot manganese dioxide. At that time the red body was distilled under reduced pressure, as the red colour could not be removed by crystallisation, and the distillate was then crystallised from acetic acid. It has since been found that the hydrocarbon, $C_{26}H_{18}$ (melting at 246°), termed *para-difluoryl*, suffers considerable, if not complete, decomposition even when distilled under reduced pressure. However, by distilling the crude product only so far as to separate the main bulk of unaltered fluorene, and treating the highly-coloured residue with cooled ether—which dissolves the red colouring matter and any unchanged fluorene—a very slightly coloured residue of the $C_{26}H_{18}$ hydrocarbons is obtained. The crude product forms about 10 per cent. of the original fluorene, and contains at least three isomers of the formula $C_{26}H_{18}$. The one present in greatest quantity, and the only one as yet examined, is that melting at 246°. This body forms long prisms, very slightly soluble in cold ether or chloroform, and only moderately in hot acetic acid. On slightly heating it above its melting point, it decomposes, forming another hydrocarbon of lower melting point, and a large amount of carbonaceous matter. It is not easily brominated; a cold solution in $CHCl_3$ may be treated with bromine without much action taking place, and, when heated, a tetrabromo-compound, extremely insoluble in all solvents, is formed, which melts, with decomposition, at about 302°. On boiling it with fuming nitric acid, a di-nitro-compound is formed. It is not very easily oxidised; the acetic solution requires to be boiled with a large excess of CrO_3. The product crystallises from acetic acid in very fine rhombs, melting at 255°, and sublimes unchanged. It has the composition $C_{26}H_{14}O_2$, and is probably an oxide not a quinone. Alkalis, bromine, and nitric acid scarcely affect it. The di-haloid derivatives of fluorene, as mentioned in the author's previous note, contrary to statements by Van Dorp and others, are readily acted upon by alkalis, halogen being removed and difluorene compounds formed; with fused or concentrated potash the action is violent, and pure products are not easily obtained. The action of alcoholic potash is more manageable, but the best result is obtained by the action of sodium ethoxide. On dissolving $C_{13}H_8Br_2$ in alcohol, and adding sodium, a green solution is formed; on dilution with water and boiling this deposits a brilliant red crystalline powder, which is exceedingly insoluble. Analysis shows it to have the composition $C_{26}H_{14}Br_2O$. This body crystallises from boiling cumene or acetic anhydride in red microscopic prisms, melting above 360°; the chloro-derivative is analogous. It appeared possible that this body might be produced by the simultaneous action of bromine and potash on fluorene; it was found, however, that the main product is monobromofluorene, identical with that already described, melting at 103-104°; this is an excellent way of making the mono-haloid derivatives of fluorene, as in the ordinary way much di-haloid derivative is always formed. Sodium ethoxide acts on monobromofluorene; the product is of a yellow colour and free from bromine. A mononitrofluorene is obtained by very careful addition of the calculated amount of nitric acid to a cooled solution of fluorene in acetic acid; it forms small prisms, very soluble in hot alcohol, and melts at 151°. The amido-compound from it is rather unstable. On heating nitrofluorene above its melting point it decomposes, one product being a $C_{26}H_{16}$ hydrocarbon that is not identical with any of those directly obtained from fluorene.—W. S.

Improvements in and connected with the Treatment of Gas-liquor for use in the Purification of Coal-gas. F. C. Hills, London. Eng. Pat. 5874, April 3, 1884.

In a previous specification (Eng. Pat. 934, March 14, 1874) the inventor proposed to heat the gas-liquor to be purified in a still, and pass the gases driven off into a scrubber, whilst in the present communication the gas-liquor is heated as it descends in the scrubber, the heat being applied at the lower part of the scrubber. By this means the temperature of the descending stream of gas-liquor is gradually raised, and most of the sulphuretted hydrogen and carbonic anhydride, and some ammonia, are expelled, the latter being absorbed by the cool gas-liquor in the upper part of the scrubber, whilst the sulphuretted hydrogen and carbonic anhydride pass from the scrubbber at the upper part as described in the previous patent.—D. B.

Improvements in the Distillation of Coal in the Manufacture of Coal-gas, for the purpose of Facilitating the Subsequent Purification of the said Gas. R. Irvine, of Royston, Granton, near Edinburgh, Scotland. Eng. Pat. 5932, April 4, 1884.

The inventor proposes to distil the coal in the presence of ammonia or its carbonate, by passing their vapour either alone or with steam into the retorts in which the coal is being carbonised. The sulphur combines with the ammonia, forming compounds of ammonia and sulphur, which may be readily arrested in the subsequent purification of the gas without the necessity for using lime or oxide of iron.—D. B.

On the Dry Distillation of Wood. M. Senff. Ber. 18, 60-64.

The author, who has had a long practical experience in the dry distillation of wood, made an extensive series of determinations concerning this special branch of chemical industry. Although the experiments were carried out in the laboratory, all conditions of the working on the large scale were carefully observed, so that the results may serve as a guide for practical work. The distillation was performed in a cylindrical retort of cast-iron, 60cm. long by 20cm. diameter, set horizontally in a small furnace. It could be hermetically closed by means of a lid and bolts. The cooling worm was very long and kept well supplied with cold water in order to effect a complete condensation, even when the distillation was carried out at the quickest rate. Air-dry wood was employed in all experiments, and great care was taken in collecting the material to be operated upon. The wood was charred without removing its bark, just as it is done on the large scale. The pieces were 20cm. long by 2-3cm. thick. If the operation of distilling was to be carried on slowly, the retort was not heated, but after charging and closing, and a uniform small fire was kept up for six hours. In a quick operation the empty retort was heated to bright redness, quickly charged with the material, closed, and a strong heat applied for three hours. The retort held from 4-6kg. wood according to quality. After finishing the distillation, the retort was kept closed till it was completely cold, and the residual charcoal was weighed immediately after opening. Its absorption of moisture was also ascertained after an exposure of several weeks to the atmosphere of a room. The term "total distillate" in the table below, means crude wood-vinegar

and tar. Both were separated by means of a separating funnel. The uncondensed gas was estimated by difference—*i.e.*, wood minus (total distillate plus charcoal) equals uncondensed gas. A determination of the quantity of methyl alcohol in the distillate is difficult and untrustworthy in working on a small scale and was therefore omitted. Besides it is known from practical experience that the yield of methyl alcohol is in direct proportion with the amount of wood-vinegar. The following table shows the results, in which *a* and *b* mean slow and quick distillation respectively :—

100 KG. AIR-DRIED WOOD YIELDED—

No.	Specimen of Wood.		Total Distillate. Kg.	Tar. Kg.	Wood Vinegar. Kg.	Wood Vinegar. % Acid.	Anhydrous Free Acid. Kg.	Charcoal. Kg.	Charcoal. Absorption of Water. %	Uncondensed Gas. Kg.
1.	Carpinus Betulus L.	*a*	52·10	4·75	47·65	13·50	6·43	25·37	6·09	22·23
	Trunk ; good state	*b*	48·52	5·55	42·97	12·18	5·23	20·47	10·03	31·01
2.	Rhamnus frangula L.	*a*	52·79	7·58	45·21	13·88	6 05	26·50	5·09	20·71
	Young trunks, without bark ; good state	*b*	45·38	5·15	40·23	11·16	4·49	22·53	6·85	32·09
3.	Alnus glutinosa L.	*a*	50·53	6·39	44·14	13·08	5·77	31·56	6·29	17·91
	Trunk without bark ; good state	*b*	47·76	7·06	40·70	10·14	4·13	21·11	9·52	31·13
4.	Betula alba L.	*a*	51·05	5·46	45·59	12·36	5·63	29·24	1·29	19·71
	Trunk good state	*b*	42·98	3·24	39·74	11·16	4·43	21·46	7·37	35·56
5.	Sorbus aucuparia L.	*a*	51·51	7·43	44·11	12·60	5·56	27·84	4·62	20·62
	Trunk; good state	*b*	46·40	6·41	39·99	10·41	4·16	20·20	8·72	33·10
6.	Fugus silvatica L.	*a*	51·65	5·85	45·80	11·37	5·21	26·69	4·61	21·66
	Trunk ; good state	*b*	44·35	4·90	39·45	9·78	3·86	21·90	8·45	33·75
7.	Fugus silvatica L.	*a*	49·89	4·81	45 08	11·40	5·14	26·19	5·95	23·92
	Branches ; good state	*b*	43·11	2·90	40·21	10·89	4·38	21·30	8·99	35·56
8.	Populus tremula L.	*a*	47·41	6·90	40·51	12·57	5·10	25·47	—	27·09
	Trunk ; good state	*b*	46·36	6·91	39·45	11·01	4·36	21·33	—	32·31
9.	Fugus silvatica L.	*a*	51·31	3·56	47·75	10 08	4·81	23·23	7·56	25·46
	Branches ; rotten state	*b*	47·32	5·99	41·33	8·88	3·67	20·98	—	31·70
10.	Quercus Robur L.	*a*	48·15	3·70	44·45	9·18	4 08	34·68	4·67	17·17
	Trunk ; good state	*b*	45·21	3·20	42·04	8·19	3·44	27·73	6·36	27 03
11.	Pinus abies L.	*a**	45·37	4·42	40·95	6·66	2·73	30·27	4·85	24·36
	Trunk ; good state	*b*	54·75	9·77	44·98	5·70	2·39	24·18	6·98	21·07
12.	Pinus Larix L.	*a*	51·61	9·30	42·31	6·36	2·69	26·74	8·08	21·65
	Trunk ; good stato	*b*	43·77	5·58	38·19	5·40	2 06	24·06	8·72	32·17
13.	Pinus abies L.	*a**	46·92	5·93	40·99	5·61	2·30	34·30	4·82	18·78
	Trunk ; rotten state	*b*	46·35	6·20	40·15	4·44	1·78	24·24	9·63	29·41
14.	Pinus abies L.	*a*	46·34	8·13	38·21	5·82	2·22	25·55	9·33	28·11
	Branches ; good state	*b*	43·85	5·44	38·41	4·20	1·61	23·35	9·93	32·80
15.	Pinus abies L.	*a*	40·53	6·99	33·54	3·31	1·12	30·24	—	29·23
	Bark	*b*	37·80	5·36	32·44	2·64	0·86	31·59	—	30·61

* Not completely charred.

Practical conclusions from the experiments : 1. The yield by weight of wood, vinegar, tar, charcoal and uncondensed gas, do not greatly vary with different kinds of woods. 2. The percentage of real acid in the wood-vinegar—*i.e.*, the yield of anhydrous acetic acid—differs very much. In this respect trees, bearing foliage, are better than pines ; wood, from the trunk, yields more acid than wood from branches ; wood in good state is preferable to such in rotten state. 3. A quick distillation yields an increased quantity of uncondensed gas, but at the cost of the amount of total distillate and charcoal. 4. A quick distillation yields a distillate poorer in acid ; and 5. The resulting charcoal is much more hygroscopic than that produced by a slow process of distilling. —S. H.

Improvements in the Distillation of Shale Coal or the like for obtaining Solid Paraffin therefrom. Robert Irvine, of Royston, Granton, near Edinburgh, Scotland. Eng. Pat. 5933, April 4, 1884.

THE object of this invention is to prevent the decomposition of the paraffin by sulphur or its compounds during the process of distillation. For this purpose the shale or coal is distilled with steam, in the presence of ammonia or ammonium carbonate, the ammonia being recovered in the usual manner, and used again for a further operation. By this treatment the yield of paraffin is said to be increased.—D. B.

Improvements in the Distillation of Mineral Oils and in the Apparatus employed therefor. W. Young and G. T. Beilby, Scotland. Eng. Pat. 6094, April 8, 1884.

THE object of this invention is the reduction of the cost of labour and fuel in the process of refining, and the more efficient fractionating of the various grades of oils, of which the crude oils are composed. The guiding principles on which the process and arrangements are founded are :—(1) continuous distillation, (2) the utilisation of the heat from the fuel employed to effect the distillation in such a manner that the high temperature, where the combustion is effective, is made to distil the oils having a high boiling point, and that as the products of combustion lose heat they are made successively to distil the more volatile oils, so that by the time they reach the chimney the heat has been fully utilised, (3) the separation of the oil vapours arising from the oils of different densities as they flow from the colder to the hotter end of the still, and (4) the conjoined heating and partial distillation of the oils on their way to the still, and the condensation of the oil vapours coming from the still in such a manner that the cold oil flowing to the still will first act as the condensing agent for the more volatile vapours from the still, and that as the oils become gradually heated by so acting as the condensing medium of the more volatile vapours, it will be made to act successively as the condensing medium of the heavier vapours, and by being thus heated and applied, will act

as a means of further fractionating the oils, and at the same time conserve the heat from the condensation of the oil vapours.—D. B.

Improvements in the Distillation of Mineral Oils, their Residues and Tars, and in the Apparatus employed therefor. W. Young and G. T. Beilby, Scotland. Eng. Pat. 8409, April 8, 1884.

The apparatus for carrying out this invention consists of an iron vessel, containing a series of iron trays placed over each other. The oils are made to flow down from tray to tray of the arrangement, whilst a current of super-heated steam which is forced upwards effects the distillation of the descending oils. The coke remaining on the trays is either removed by mechanical scrapers or by hand through openings. Instead of trays the apparatus may be filled with broken coke, fire brick, hollow iron balls or similar substances presenting a large surface and having considerable spaces between.—D. B.

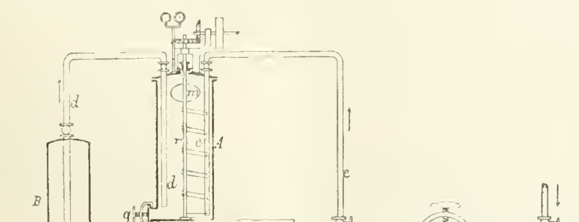
Improvements in the Bleaching or Purifying of Dark Coloured Mineral and other Distillable Oils. W. P. Thompson. Eng. Pat. 6786, April 25, 1884.

This patent is a reissue of part of the invention protected by provisional application (Eng. Pat. 5969, December 31, 1883), the remaining part of the provisional specification being covered by patent No. 5208. It consists essentially in distilling the oil through a layer of thoroughly desiccated hot porous material, preferably animal charcoal with or without superheated steam, and with or without atmospheric pressure. The vapour then passes to the condensing apparatus, which consists of a single worm in a cooling liquor, or it can be composed of a rather hot worm, then a collecting receptacle, then another worm kept a little cooler than the last, then another collecting receptacle and so on. Thus the oils of higher boiling point are still further fractionated from the lower, being deposited in the first receptacle. From the last of the receptacles (and in most cases one worm and one receptacle will suffice) a pipe is led to an air pump so as to keep up a vacuum, and enable the oil to be distilled at a lower temperature, and also to come over of a lighter colour.—D. B.

IV.—COLOURING MATTERS AND DYES.

Apparatus for the Manufacture of Colours containing Sulphur. Dingl. Polyt. Journ. 254 [8], 345.

M. Majert, of Heidelberg, has found (Ger. Pat. 27,277, October 25, 1883) that in the preparation of colouring matters from aromatic paradiamines by Lauth's process—treatment with sulphuretted hydrogen and ferric salts in a cold dilute, acid solution—bye-products of a red colour, and containing a larger amount of sulphur, are formed, and that the greater part of the sulphuretted hydrogen is oxidised to water and sulphur without taking part in the reaction. In order to obtain a good yield of colouring matter it is necessary to work with very dilute solutions, so that a sufficiently large excess of sulphuretted hydrogen is retained in the liquor. The best yield of colouring matter is obtained by employing for 1 part phenyleneparadiamine 200 parts of the solvent saturated with sulphuretted hydrogen at 15°, this being three times the amount of sulphuretted hydrogen required by theory. The yield of colouring matter increases with the amount of acid contained in the solution, but it is out of proportion with the cost involved by the employment of such large quantities of liquor which have to be dealt with when a certain amount of acid is exceeded. To obviate these drawbacks, and allow of the use of a more concentrated liquor, a lead-lined boiler A, holding 2 cubic metres and standing a pressure of 25 atmospheres, is employed. It is furnished with a copper agitator *r*, vacuum and pressure gauges, manhole *m*, and a safety valve, opening at 20 atmospheres' pressure. Fifty kilos. paraphenylenediamine dissolved in 1200kilos. sulphuric acid at 25° B. are introduced into the boiler A; the safety valve is then lifted and 40kilos. of compressed sulphuretted hydrogen are allowed to pass through the pipe *d* into A. The valve is closed again as soon as all the air in the boiler A has been displaced. The temperature of the liquor in A falls considerably, whereas the pressure rises to five atmospheres. The agitator is then set in motion, and a 20 per cent. solution of ferric sulphate is by means of compressed air transferred from the vessel C through the pipe *c* into A, until a vacuum of 200 millimetres is reached. It is advisable to cool the boiler A while the reaction is proceeding. When it is finished, a green solution, containing ferrous sulphate and sulphur in solid form, is obtained, which is discharged through *g* into a tank containing about 2 cubic metres of water. The solution, which now assumes a violet colour, is filtered, and the colouring matter precipitated by means of zinc chloride and common salt. It dyes violet shades. Paramidoethylaniline, under the same conditions, forms a blue; para-amidodimethylaniline, para-amidodiethylaniline, and para-amidomethylethylaniline, greenish-blue colouring matters.—F. M.



Action of Alcohol on Diazo-Compounds. Ira Remsen. Ber. 18, 65.

A. W. Hofmann, Hallen, and of Wroblewsky (Ber. 17, 1917, 1887, and 2703), and other investigators, have found that a diazo-compound, when decomposed by boiling with alcohol, does not *always* yield the corresponding hydro-carbon as previously supposed, but that *sometimes* the ethyl-ether of the corresponding phenol is produced. The author points out that Brown (Amer. Chem. Journ. 4, 374) has also made the same observation, obtaining ethoxymetatoluic acid by boiling the diazo-compound of amidometatoluic acid with alcohol. Palmer has just found that by the decomposition of the diazo derivative of amido-orthotoluene sulphonic acid by alcohol, both orthotoluene sulphonic and ethoxyorthotoluene sulphonic acids are formed, their relative proportions depending apparently on the pressure under which the

decomposition was carried out. The author is now investigating the influence of pressure on this decomposition of diazo-compounds by alcohols.—S. H.

Conversion of Phenols into Amines. K. Buch. Ber. 17, 2634.

BENZENE-PHENOL and *p*-toluidine, or *p*-cresol and aniline, on heating with zinc chloride from 260° to 300°, yield phenyl-*p*-tolylamine

$$C_6H_5.NH_2 + C_7H_7.OH = (C_6H_5.C_7H_7)NH + H_2O.$$
$$C_6H_5.OH + C_7H_7.NH_2 = (C_6H_5.C_7H_7)NH + H_2O.$$

Also by heating benzene-phenol and *p*-toluidine with calcium chloride to 300°, phenyl-*p*-tolylamine is formed, although in very small quantity. A better yield of the mixed secondary amine was obtained by the action of antimony trichloride on a mixture of aniline and *p*-cresol. Along with this diphenylamine was formed, and metallic antimony obtained. The mixed secondary amine evidently escapes the double decomposition of the aniline with *p*-cresol, whilst the diphenylamine escapes that of the aniline with its hydrochloride. By heating *p*-toluidine and benzene-phenol with phosphorus pentoxide, no phenyl-tolylamine was obtained, but only ditolylamine. By the action of ammoniacal zinc chloride, or continued heating to 300° and above that temperature, *p*-cresol was converted into *p*-toluidine, concurrently some di-*p*-tolyloxide was obtained. The oxide crystallised in silky plates or needles, was somewhat sparingly soluble in alcohol, melted at 165°, and is a volatile substance. Di-*p*-tolyloxide was also formed by heating *p*-cresol with zinc chloride, or with the zinc chloride-aniline compound. Aniline and phenol yield, on heating with excess of calcium chloride at 300°, diphenylamine, but only in small quantity. Diphenylamine is formed along with metallic antimony and resinous matters, by the action of antimony trichloride or aniline alone, but in much larger quantity, when for aniline, a mixture of aniline and phenol with its hydrochloride is substituted. In this case, the reaction of the aniline associates itself with that with phenol.—W. S.

Orthonitraniline-sulphonic Acid and Orthonitraniline. R. Nietzki and T. Benckiser. Ber. 18, 294.

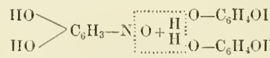
THE authors prepare this acid by nitrating the acetyl derivative of sulphanilic acid. For this purpose the sodium salt of acetyl-sulphanilic acid is dissolved in conc. H_2SO_4, and the calculated amount of HNO_3, previously mixed with H_2SO_4 added. The mixture is run on to ice, saturated with lime, and the lime salt at once decomposed with sulphuric acid, by which method the acetyl group is at the same time eliminated. On heating the potassium salt to 170-180° with conc. HCl in a closed tube the sulpho group is replaced by hydrogen, and orthonitraniline (m.p. 71·5°) obtained. Starting from acetanilide and treating this with fuming H_2SO_4 the authors have prepared sulphanilic acid. On the addition of nitric acid as before, nitraniline-sulphonic acid and nitraniline may be obtained in nearly theoretical quantities. A further study of the acetyl derivatives of naphthylamine sulphonic acid is intended.—J. B. C.

Azonaphthalene. R. Nietzki and O. Goll. Ber. 18, 297.

IN order to determine whether the substance, called by Laurent "naphtase," is actually an azonaphthalene as supposed, the authors have succeeded in preparing from amido-azonaphthalene a compound having the formula $C_{20}H_{14}N_2$, differing in its properties from naphtase of Laurent, but possessing colouring powers analogous to azobenzene. The action of ethylnitrite on amido-azonaphthalene, according to Griess's method, does not eliminate the amido group; but by treating amido-azonaphthalene sulphate with sulphuric acid and sodium nitrite at a temperature of 10-15°, diazo-azonaphthalene sulphate crystallises out on standing. This yields α-azonaphthalene when boiled with alcohol, nitrogen and aldehyde being at the same time evolved. By adding water gradually to the alcoholic solution, α-azonaphthalene separates out as a brown flocculent precipitate, which may be purified by recrystallisation from alcohol. Azonaphthalene obtained thus melts at 190°, and dissolves in the ordinary solvents with characteristic colours.—J. B. C.

Colouring Matters from Phenols. H. Brunner and W. Robert. Ber. 18, 373.

IN the preparation of nitrosoresorcin and nitrosoorcin by the action of amylnitrite on the sodium salts of the respective phenols, and precipitation with sulphuric acid, the authors observed that from the washings a new substance separated out on standing. This was dissolved in ammonia, and by the addition of hydrochloric acid a reddish-brown precipitate formed, part of which dissolved in ether. The portion soluble in ether dissolves in alkalis with a violet colour and brown fluorescence, and has the formula $C_{18}H_{15}NO_6$. According to the authors these compounds are produced by the union of one molecule of the nitrosophenol with two molecules of the phenol, the oxygen of the nitroso group uniting with two hydrogens of the hydroxyl groups to form water as follows:—

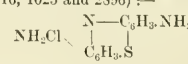


$$= (OH)_2C_6H_3N(OC_6H_4OH)_2 + H_2O$$

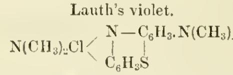
The portion insoluble in ether is likewise a colouring matter dissolving in alkalis, and concentrated H_2SO_4 with a violet or blue colour. This compound has not been fully investigated, and will form the subject of further research.—J. B. C.

Methylene Blue and Related Colouring Matters. August Bernthsen. Ber. 17, 2854.

THE author has proposed the following constitutional formulæ for Lauth's violet and methylene blue (*Berl. Ber.* 17, 611; 16, 1025 and 2896):—

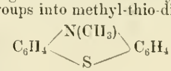


Lauth's violet.

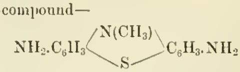


Methylene blue.

In support of this view the author draws attention to the analogous formation of these colouring matters, and those of the rosaniline group from the leuco-bases, and to their monovalent character. If the above formulæ are correct, it might be inferred that by the introduction of two amido groups into methyl-thio-diphenylamine—



a diamido-compound—



would be formed, and not a colouring matter analogous to Lauth's violet, and this is in fact the case. By the action of fuming nitric acid the methyl-thio-diphenylamine is converted into a dinitro-methyl-diphenylamine sulphoxide—

$$CH_3.N:(C_6H_3.NO_2)_2:SO$$

which differs from the homologous dinitro-diphenylamine sulphoxide, $NH(C_{12}H_6)(NO_2)_2SO$, in being insoluble in dilute alkalis. The nitro-compound is reduced by stannous chloride and hydrochloric acid, and the resulting amido-compound is insoluble in hydrochloric acid, but dissolves readily in water. The hydrochloride crystallises in colourless prisms. Ammonia liberates the base from the aqueous solution of its salt. It is readily oxidised. Ferric chloride colours the solution of the hydrochloride blue-green, and by addition of zinc chloride and common salt an extremely unstable crystalline compound is precipitated. This compound differs greatly from Lauth's

violet, which is very stable. Lauth's violet may be prepared not only by conversion of thio-diphenylamine into the amido compound, but also by introduction of sulphur into para-amido-diphenylamine, by simply heating the two substances together, thus:—

$$NH\left\langle\begin{matrix}C_6H_4-NH_2\\C_6H_4-NH_2\end{matrix}\right. + 2S = NH\left\langle\begin{matrix}C_6H_3(NH_2)\\C_6H_3(NH_2)\end{matrix}\right\rangle S$$

It has also been prepared qualitatively by heating para-nitroaniline with sulphur.—S. Y.

Methylene Blue and Related Colouring Matters. August Bernthsen. Berl. Berl. 17, 2857.

THE author has shown (*Berl. Ber.* 17, 611) that by the action of fuming nitric acid on thio-diphenylamine α- and β-dinitro-diphenylamine sulphoxides are formed, and that these substances, by reduction and subsequent oxidation, yield Lauth's violet and an isomeric colouring matter. The author has prepared a new colouring matter by introducing only one nitro group into thiodiphenylamine. When a weaker nitric acid is employed, besides the two dinitro bodies, a mononitro compound

$$NO_2.C_6H_3\left\langle\begin{matrix}NH\\SO\end{matrix}\right\rangle C_6H_4$$

is formed. The leuco compounds were obtained by the action of stannous chloride and hydrochloric acid, and after the removal of the tin, by means of zinc, a compound separated out, which gave a deep violet-red colour with ferric chloride, while the isomeric diamido-compounds remained in solution. The base was set free by an alkali, and was found to have the composition

$$NH_2.C_6H_3\left\langle\begin{matrix}NH\\S\end{matrix}\right\rangle C_6H_4$$

It forms glittering white needles, which are soluble in alcohol and ether, and though readily oxidised, it is more stable than Lauth's white (diamido-thiodiphenylamine). The hydrochloride, which crystallises in small white or grey scales, was analysed. On addition of ferric chloride to its acid solution, a violet-red colouring matter is formed, which must have the constitution

$$NH\left\langle\begin{matrix}N-C_6H_4\\ | \quad\quad | \\C_6H_3.S\end{matrix}\right.$$

and which may be called imido-thiodiphenylimide. It may be precipitated by addition of water to its alcoholic solution in rust-coloured crystals, which are readily decomposed. It is reduced by ammonium sulphide, forming a leuco-base. The hydrochloride is best obtained by passing hydrochloric acid gas into an ethereal solution of the base. It forms a well-crystallised double salt with zinc-chloride, the composition of which is

$$2C_{12}H_8N_2S,HCl + ZnCl_2.$$

The salts of imido-thiodiphenylimide colour silk a violet-red with a brownish tint. They have little value as colouring matters. The same substance may be prepared by the introduction of sulphur into the para-amidodiphenylamine obtained from Orange IV.,

$$C_6H_4(SO_3Na) - N = N - C_6H_4 - NH - C_6H_5,$$

by the action of ammonium sulphide. When heated with sulphur, the following reaction takes place—

$$NH\left\langle\begin{matrix}C_6H_5\\C_6H_4NH_2\end{matrix}\right. + 2S = NH_2.C_6H_3\left\langle\begin{matrix}NH\\S\end{matrix}\right\rangle C_6H_4.$$

The identity of the two bodies and their leuco compounds was proved by a comparison of their properties. The above-mentioned method of formation of amido-thiodiphenylamine shows that the amido and imido group stand in the para position with regard to each other.—S. Y.

Methylene Blue and Related Colouring Matters. August Bernthsen. Ber. 17, 2860.

COLOURING matters are produced by the introduction of amido groups into thiodiphenylamine, and subsequent removal of two hydrogen atoms. The author and A. Simon have succeeded in preparing similar colouring matters by introducing hydroxyl groups. It was not considered probable that hydroxyl groups could be introduced into thiodiphenylamine, and therefore hydroxydiphenylamine was heated with sulphur, so as to form the thio compound. Paraoxydiphenylamine

$$C_6H_5.NH.C_6H_4.OH(p)$$

was prepared by Calm's method (*Berl. Ber.* 16, 2786; 17, 2431) from hydro-quinone, aniline, and zinc chloride, and the crystals were melted with sulphur, when the following reaction took place:

$$C_6H_5.NH.C_6H_4.OH(p) + 2S = OH.C_6H_3\left\langle\begin{matrix}NH\\S\end{matrix}\right\rangle C_6H_4 + H_2S.$$

The fused mass containing hydroxythiodiphenylamine was powdered, extracted with hydrochloric acid, and the residue dissolved in alcohol and a little hydrochloric acid, and treated with ferric chloride, when a brown precipitate of oxythiodiphenylimide was produced. The substance was purified and analysed. It dissolves easily in aniline, and crystallises from its solution in this substance in dark microscopic needles. Its method of formation, together with the fact that it possesses neither acid nor basic properties, shows that its constitution is

$$O\left\langle\begin{matrix}N.C_6H_4\\ | \\C_6H_3-\end{matrix}\right\rangle S$$

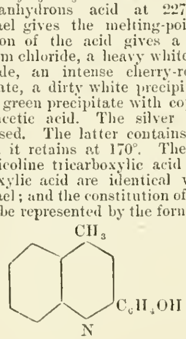
It is analogous to the amido-compounds, and is a colouring matter.

Reducing agents convert oxythiodiphenylimide into the hydroxy compound, which has the properties of a phenol, and is taken up by alkalis from its ethereal solution. It is oxidised on exposure to air, and is reconverted into oxythiodiphenylimide. The alkaline solution resembles that of indigo, in its liability to oxidation, and in its colouring properties, but the scum which forms on the surface has a red-brown colour. The composition of the leuco compound $C_{12}H_9NSO$ was confirmed by analysis.—S. Y.

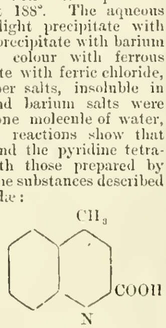
Note on Flavaniline. O. Fischer and E. Täuber. Ber. 17, 2925.

EXPERIMENTS on the oxidation of flavenol, obtained from flavaniline, show that the latter substance belongs to a new class of quinoline colouring matters. By oxidation of flavenol a lepidine carboxylic acid is formed, and this on further oxidation yields a picoline tricarboxylic acid. The authors now find that the final oxidation product of flavenol is a pyridine tetracarboxylic acid, identical with that described by R. Michael (*Ann. Chem. Pharm.* 225, 142). Picolinetricarboxylic acid was prepared by treating nine molecules of potassium permanganate with one of flavenol. The oxidation of 30grm. of flavenol was completed in about three days. Oxalic acid was found to be present in considerable quantity. The acid melts at 230-232°, decomposes rapidly at 236°, and begins to darken at 190°. A dilute aqueous solution of the acid gives a brown-red colouration with ferrous sulphate, a very dilute solution a gold-yellow colour. Calcium chloride gives a white precipitate, insoluble in hot water, with a concentrated solution of the ammonium salt. With a very dilute solution, however, no precipitate is formed. The acid thus resembles malonic acid. Barium chloride gives a similar precipitate; copper acetate and sulphate produce no precipitates. This picoline tricarboxylic acid is identical with that prepared by Michael from collidinemonocarboxylic acid, for on oxidation they both yield the same pyridine tetracarboxylic acid. This acid was prepared directly from flavenol, by treating one molecule

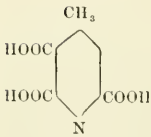
dissolved in dilute caustic soda with eleven molecules of permanganate. The reaction was completed by heating the mixture on the water-bath for a day. The solution was filtered, neutralised with dilute nitric acid, treated with lead nitrate and the lead salt decomposed by sulphuretted hydrogen. Oxalic acid was removed by means of calcium chloride. The pure acid was prepared from the little soluble copper salt. After removal of water at 115° the composition of the acid was found to be $C_9H_5NO_8$. The acid dried at 100°, melts at 187°, the anhydrous acid at 227°, with decomposition. Michael gives the melting-point 188°. The aqueous solution of the acid gives a slight precipitate with calcium chloride, a heavy white precipitate with barium chloride, an intense cherry-red colour with ferrous sulphate, a dirty white precipitate with ferric chloride, and a green precipitate with copper salts, insoluble in hot acetic acid. The silver and barium salts were analysed. The latter contains one molecule of water, which it retains at 170°. These reactions show that the picoline tricarboxylic acid and the pyridine tetracarboxylic acid are identical with those prepared by Michael; and the constitution of the substances described must be represented by the formulæ:



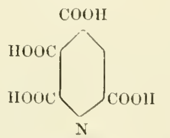
Flavenol.



Lepidine carboxylic acid.



Picoline tricarboxylic acid.



Pyridine tetracarboxylic acid.

—S. Y.

On β-Amido-alizarin. Heinrich Brunner and Ernest Chuard. Ber. 18, 445.

If in the method of preparing alizarin blue another polyatomic alcohol (erythrite, mannite, glucose or saccharose), be substituted for the glycerine, an analogue of alizarin blue is not produced, but instead the nitro-alizarin is reduced to β-amido-alizarin. For instance, if a mixture of nitro-alizarin (1 part) and erythrite (5 parts) is heated to 100° C. with 10 parts of H_2SO_4, and the melt poured into water, a precipitate is produced, which, after recrystallising from alcohol, forms the glistening red prisms of β-amido-alizarin. It dissolved in caustic alkalies with a blue colour; and dyed red with alumina mordants, and greyish violet with iron mordants. The yield is small. β-amido-alizarin (mixed possibly with some alizarin blue) is also formed by the action of H_2SO_4 on a mixture of nitro-alizarin and allyl alcohol.

—A. G. G.

On Compounds of Nitrosonaphthols and Nitrosonaphtholsulphonic Acids, with Iron and Cobalt. O. Hoffmann. Ber. 18, 46.

Several nitrosonaphtholsulphonic acids—*e.g.*, that obtained from Schaeffer's β-naphtholmonosulphonic acid, etc.—yield, with iron and cobalt salts, green or brown-red dye-stuffs, which are the subject of a patent taken out by Messrs. Gans and Co., Frankfort-on-the-Maine. The metals in these compounds cannot be precipitated by alkalis or their carbonates. A determination of the iron in the green dye from nitroso-α-naphtholsulphonic acid, showed it to contain 7·9 per cent. Fe. β-nitroso-α-naphthol and α-nitroso-β-naphthol show a similar behaviour with iron and cobalt salts; but their precipitates are not applicable for dyeing. Only orthonitrosonaphthols give precipitates with iron and cobalt; and it therefore seems probable that the ortho position of the nitroso and hydroxyl group is necessary for the reaction.—S. H.

On Pseudocumidine. S. Haller. Ber. 18, 89-94.

A. W. Hofmann, and recently Liebermann and Kostanecki, have shown that commercial crystallised cumidine, prepared on the large scale from dimethylxylidine, is identical with Schaper's pseudocumidine, derived from pseudocumene. The author has again investigated this question from other points of view, and has arrived at the same conclusions as the former investigators. In order to obtain the hydrocarbon, diazocumidine sulphate was treated with alcohol; but the reaction, as Hofmann and Wroblewski have recently shown, does not proceed in the usual manner, but yields the ether of pseudocumol. However, by treating pseudcumylhydrazine

$$NH_2.NH.C_6H_2(CH_3)_3$$

with copper sulphate—a new reaction, suggested by Baeyer—the hydrocarbon can be easily prepared. The hydrazine was produced by converting pseudocumidine into the diazo compound

$$C_6H_2(CH_3)_3.N:N.SO_3Na_2 + 2\tfrac{1}{2}H_2O$$

reducing it with zinc-dust to

$$C_6H_2(CH_3)_3.NH.NH.SO_3Na + 1\tfrac{1}{2}H_2O$$

and treating the latter with dilute hydrochloric acid. For the purpose of converting pseudocumylhydrazine into the hydrocarbon pseudocumene, the former is boiled with water, while a copper sulphate solution is gradually added until the liquor has a permanent greenish-blue colour. The reaction probably proceeds thus:—

$$NH_2:N.C_6H_2(CH_3)_3$$
$$2CuSO_4 + H_2O = C_6H_3(CH_3)_3 + Cu_2O + N_2 + 2SO_4H_2.$$

The free hydrocarbon showed all the characteristic properties of that detected by Beilstein and Kögler in coal-tar, or prepared synthetically from bromised xylols by Fittig, Jannasch, Ernst, and Laubinger. In order to determine the position of the amido-group in pseudocumidine, the cyanide of the hydrocarbon $C_6H_2(CH_3)_3CN$ was prepared by treating a solution of diazopseudocumenechloride with copper sulphate and potassium cyanide. After saponifying it with an alcoholic potash solution, the acid formed, durylic acid, $C_6H_2(CH_3)_3COOH$ was liberated by adding sulphuric acid and distilling with steam. The durylic acid thus obtained is identical with that prepared by Jannasch, from pseudocumene; and whereas on the one hand there can be no further doubt that commercial cumidine is identical with Schaper's pseudocumidine, we obtain on the other hand a new argument for the presumption that the position of the substituents $NH_2 : CH_3 : CH_3 : CH_3$ is 1 : 2 : 4 : 5, as Schaper has shown for his amido-compound.—S. H.

Derivatives of the Two Isomeric α-and β-Napthol azobenzenes. L. Margarry. Gazz. Chim. 14, 271.

Two isomeric monobromo derivatives are formed by the direct action of bromine on an acetic acid solution of α-naphtholazobenzene. They are analogous to those obtained from β-naphtholazobenzene, and correspond to the two isomeric α-naphthol-azobenzenes described by Typke. They melt at 185 and 195-196° respectively, and do not resemble the brom derivatives of β-naphthol-azobenzene in their solubilities. By reduction with tin and hydrochloric acid parabrom aniline and amido α-naphthol were obtained.—S. R.

Improvements in the Manufacture of Colouring Matters. Gerard Wenzeslaus von Nawrocki, Berlin. From Paul Böttiger, of Lodz, Russia. Eng. Pat. 4415, March 5, 1884.

This invention claims the series of colouring matters produced by combining tetrazodiphenyl with α- and β-

naphthylamines and their sulphonic acids. The first compounds which have the formula

$$\begin{array}{l} C_6H_4.\ N_2.\ C_{10}H_6.\ NH_2(\alpha \text{ or } \beta) \\ | \\ C_6H_4.\ N_2.\ C_{10}H_6.\ NH_2(\alpha \text{ or } \beta) \end{array}$$

are insoluble in water, but soluble in alcohol, and are made soluble by conversion into their sulphonic acids, or the naphthylamines can be first sulphonated, and then combined with the tetrazo-salt in the usual way. The colours are of various shades of red, and are especially useful for cotton dyeing.—R. M.

Improvements in the Preparation of Purple, Blue, and Green Colouring Matters suitable for Dyeing and Printing, from Halogen-Derivatives of Tetramethyldiamidobenzophenone and Analogous Ketone Bases. John Henry Johnson, London. From Dr. H. Caro, Ludwigshafen, Germany. Eng. Pat. 5038, March 18, 1884.

THE colouring matters described are all triphenyl methane derivatives or allied bodies, and the haloid-ketone derivatives are prepared in the manner described in a previous specification (Eng. Pat. 4850, 1884). In order to bring about condensation between these ketone halogen derivatives and aromatic bases it is not necessary to isolate the haloid derivatives in the first instance, but the two operations can be carried on at once by mixing the ketone base, the deoxidising and halogenising agents and the aromatic base. The five following examples illustrate the application of the process to the production of purple colouring matters :—(1) Tetramethyldiamidobenzophenone (10 parts) is mixed with twice its weight of dimethylaniline, and heated to 100° C., and when cool mixed with six parts of PCl_3. The halogenising action first occurs, and then condensation takes place with the dimethylaniline producing "methyl purple," the salts of which are crystalline. (2) Oxychloride of phosphorus is employed, and the order of mixture reversed, 25 parts of dimethylaniline being mixed with 10 parts of the oxychloride, and then 10 parts of dry powdered tetramethyldiamidobenzophenone gradually added, the whole mixture being finally heated to 90-100° C. By employing carbon oxydichloride as the halogenising agent, a complete synthesis of "methyl purple" can be effected in a combined series of operations from tertiary alkalised derivatives of aniline and its homologues. Bluer shades of purple are obtained by using tetraethyl instead of the tetramethyl ketone. (3) The tetraethyldiamido ketone is in this process condensed with dibenzylaniline by means of phosphorus oxychloride, the final product being "benzyl violet." (4) A phenylated "methyl purple" is produced by condensing the tetramethylated ketone with diphenylamine by means of phosphorus trichloride, toluol being used as a solvent. The salts of this colour, and of the corresponding compound from methyldiphenylamine, are soluble in hot water. (5) Purple colouring matters are also obtained by condensing the tetramethyl ketone with dimethylanisidine (ortho) or tetramethylmetaphenylenediamine. Blue colouring matters of the same series are obtained by condensing the haloid derivative of ketone base with tertiary alkylised derivatives of α-naphthylamine, such as dimethyl-α-naphthylamine, which gives a purplish blue, or phenyl-α-naphthylamine, which gives a bright, pure blue. In a similar manner green colouring matters are produced by the condensation of the haloid derivatives of the ketone base, with quinoline. Tetraethyldiamidobenzophenone gives a yellower shade of "quinoline green" than the tetramethyl-derivative.—R. M.

Improvements in the Manufacture of Yellow Colouring *Matters.* Fritz Machenhauer, Reddish, near Manchester. Eng. Pat. 5458, March 26, 1885.

THESE colouring matters are prepared from triphenylated derivatives of rosaniline; more especially the blue produced by the action of aniline upon aurine known as "azuline." Two methods are given for converting "azuline" into the desired yellow dyestuff :—(1) The glacial acetic acid solution of the blue is acted upon by nitric or nitrous acid. (2) The sulphonic acid of "azuline" is acted upon by nitric or nitrous acid.—R. M.

Improvements in the Preparation of Yellow Colouring Matters suitable for Dyeing and Printing from Tetramethyldiamidobenzophenone and Analogous Ketone Bases, or their Halogen Derivatives. John Henry Johnson, Lincoln's Inn Fields, London. From Dr. H. Caro, Ludwigshafen, Germany. Eng. Pat. 5512, March 26, 1884.

THESE colouring matters, for which the inventor proposes the name of "auramines," are produced directly by the action of ammonia upon the CO group of tetramethyldiamidobenzophenone, or indirectly by the action of ammonia upon the halogen derivatives of the ketone bases. For the carrying out of the direct method, a salt of ammonia must be employed, and heat is necessary to bring about the reaction. Thus, 10 parts of dry, finely powdered tetramethyldiamidobenzophenone, 10 parts of salammoniac, and 10 parts of dry zinc chloride, are mixed and heated in an enamelled iron pan in an oil-bath to about 200 C (outside temperature) for 5-6 hours, till a sample of the melt dissolves completely in hot water. The hydrochloride of the colouring matter, after purification, is crystalline. The indirect method, which is the less advantageous, is carried out by chlorinating the tetramethyl ketone in nitrobenzene solution, by means of oxychloride of phosphorus, and then acting upon the product with ammonia of 0·95 sp. gr. The auramines are all basic dyes, the free bases being colourless, and the salts yellow without any fluorescence in solution. These compounds are decomposed by boiling with strong acids, or with water, ammonia and the original ketone base being regenerated.—R. M.

Improvements in the Preparation of Yellow, Orange, and Orange-Brown Colouring Matters, suitable for Dyeing and Printing from Tetramethyldiamidobenzophenone and Analogous Ketone Bases, or their Halogen Derivatives. John Henry Johnson, London. From Dr. H. Caro, Ludwigshafen, Germany. Eng. Pat. 5741, March 31,

THE colouring matters referred to are substitution derivatives of the "auramines" referred to in the previous specification. Three processes are given for their preparation :—(1) The auramines produced by the methods described in the former patent are heated with primary amines in precisely the same manner as when rosaniline is phenylated by the action of aniline. In this way phenyl, tolyl, xylyl, naphthyl, etc., auramines are produced. (2) Primary amines or their secondary methyl, ethyl, etc., derivatives are made to react upon the haloid derivatives of the ketone bases. (3) This method, which is the most direct and economical, depends upon the action of aromatic amines upon the CO group of the tetra-alkylised ketone base. The invention is confined to aniline and its homologues, naphthylamine, chloraniline, meta and paraphenylene diamine, etc. These amines must be employed in the form of salts and heat is applied, the yield of colouring matter being greatest in the presence of zinc chloride. Phenyl-auramine, which may be regarded as a type of this class of colouring matters, is a bright orange-red powder, soluble in water, and decomposed by heating with acids into aniline and tetramethyldiamidobenzophenone. It produces orange shades upon wool or mordanted cotton. The corresponding colours from the diamines mentioned, and from the naphthylamines, give various shades of orange-brown.—R. M.

Process for the Separation of the Azo-Colours which are prepared from Diazotized β-Naphthylaminemonosulphonic acids by Combination with α-Naphtholmonosulphonic Acids. Dahl and Co., of Barmen. Ger. Pat. 30,640, May 20, 1884.

WHEN a solution of an azo-dye is prepared by the action of the diazotized difficultly soluble β-naphthylamine-

monosulphonic acids on the α-naphthol-monosulphonic acids, which correspond to the naphthionic and naphthalidamic acids, an azo-dye separates out either directly or on addition of a little salt. This azo-dye is derived from the β-naphthylamine monosulphonic acids marked I. and II., and already referred to in Ger. Pat. 29,084. In the filtrate the dye of the III. or new β-napthylamine-monosulphonic acid, remains in solution, and can be separated by salting out.—W. S.

An Improved Method of Preparing Alizarin and other Anthracene Colouring Substances. William Edward Gedge, London. From Gustav Jagenburg, Sweden, and Dr. C. Leverkus and Sons, Leverkusen, Germany. Eng. Pat. 15,456, November 24, 1884.

THE object of the present invention "is to obviate the expensive and troublesome oil impregnation," the colouring matters being rubbed in the dry state with oils or fat so as to prepare them for printing.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in the Treatment of Vegetable and other Tissues or Fibres for the Purpose of Preserving or Waterproofing the same. Arthur William Lovell Reddie. A Communication from Messieurs Dillies & Co. Eng. Pat. 5317, March 22, 1884.

THE process of preserving does not present any novel feature, as it simply consists in soaking the article in a solution of tannic acid derived from gall-nuts, sumach, etc. To render tissues waterproof as well as imperishable they are, after being first treated as above, placed in a bath of the following composition until thoroughly saturated :—

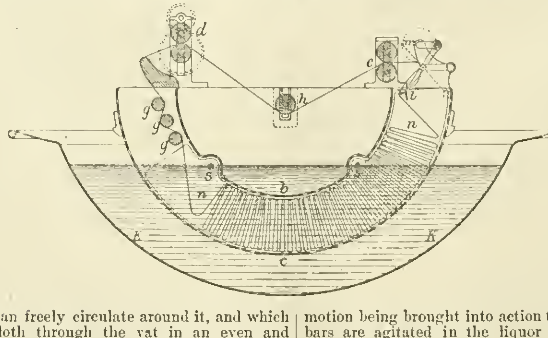
Linseed oil	500 Litres.
Birchbark distilled oil	20 to 25 „
Yellow litharge (litharge jaune)	1 to 2 Kilos.
White lead	1 to 2 „
Talc	1 to 2 „

In certain cases 1 to 4kilos. sulphate of iron may be added. These constituents are well mixed and boiled until everything is completely dissolved. The bath is then allowed to cool down to 200° F., and 10 to 20kilos. of animal or mineral wax added.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Vat Appliance for Dyeing Fabrics in an Unstretched Condition. Dingl. Polyt. Journ. 1884, 254, 207.

AN apparatus by means of which the cloth may be passed through the dye-bath in an unstretched state, so that the liquor can freely circulate around it, and which conducts the cloth through the vat in an even and uniform manner, leaving it at the same time exposed to view where it enters and leaves the former, has been patented by F. Braun, of Vogelsmühle, near Lennep (Ger. Pat. 27,560, Nov. 25, 1883). A mould-shaped conducting channel formed by the two half round perforated sheets b and c and two movable side walls n (the distance between which can be adjusted by means of the screw spindles s to suit the width of the cloth to be dyed) is suspended in the vat K. The cloth is in front of the rollers d attached to an endless web which continually remains in the apparatus, and after passing through the rollers e is folded by the attachment l m. It is then being conducted through the dye-bath in a folded condition. The whole apparatus rests on the rim of the dye-beck and is easily removable. The gearing is fixed to the latter, and is by means of a coupling connected with the driving shaft situated above the rollers d.—F. M.



Preparation or Compound to be employed in the Finishing or Surfacing of Printing Rollers and Blocks, and other Articles. A. Barrett, London. Eng. Pat. 4153, February 29, 1884.

THE emery wheels and lumps of pumice stone, which have hitherto been employed for this purpose, leave the surfaces with burrs, and less smooth and even than is desirable. The inventor employs pumice stone, broken into small pieces or powdered, and mixed with a sufficient quantity of plaster of Paris to agglomerate it into a solid mass, capable of being moulded into any required shape. The plaster of Paris may be replaced by other materials, provided that they are not harsh or gritty.—E. G. C.

Machinery, etc., for Bleaching, Dyeing, Sizing, or Washing Hanks of Yarn. Peter Thomas, Manchester. Eng. Pat. 6043, April 7, 1884.

THE vats in which the various operations are to be performed are arranged side by side in a row. Rails are laid on each side of the series of vats, on which a carriage runs, and may be stopped at any required vat. This carriage supports a framework by means of shafts at the top of the carriage, provided with pulleys and ropes. These ropes are at one end connected with the framework and counterpoised at the other end, so that the frame may be lowered into and raised out of such vat as the carriage may be over. Removable cross-bars, which two by two are arranged to take a number of hanks, are carried on each end respectively by two longitudinal bars, and these latter are suspended from two shafts, forming a part of the framework, by means of levers working on eccentrics and fixed on the shafts. The eccentric motion imparts a reciprocating motion to the longitudinal bars, thus causing the cross-bars to change their respective position continually from a higher to a lower level, and so the yarn is kept in constant agitation in the liquor. The various parts are suitably connected, so that the carriage may be run to any required vat, the framework lowered, and the eccentric motion being brought into action the hanks on the cross-bars are agitated in the liquor contained in the vat. When the operation is over, the framework is raised and the carriage run to such other of the vats as is next required. (Drawings given.)—W. E. K.

Dyeing Garments, etc. Joseph P. Delahunty, Pittston, Pennsylvania, U.S.A. Eng. Pat. 11,231, August, 13, 1884.

A LARGE revolving octagonal reel or cage, the faces and ends composed of open slab work, is supported on its axis over the dye-vat. On the interior surface a series of pins project from the periphery towards the axis of the wheel, and a door is provided for the insertion and removal of the goods. The lower half of the cage only is immersed in the liquor, and, on the rotation of the reel, the goods are caught by the pins and carried forward, and are dropped again into the liquor when that part of the reel reaches its highest point. For removal of the goods a screen is inserted extending from the axis to the periphery of the reel, and by a revolution of the cage the goods are brought up on this to the surface. (Drawing given.)—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

On Pyrosulphates. H. Schulze. Ber. 17, 2705.

THE author has prepared salts of pyrosulphuric acid by the action of sulphuric anhydride on sulphates at ordinary temperatures, a method similar to that adopted by R. Weber. The author in the present paper confirms the results so far attained by R. Weber, and adds some new observations of his own. In the first place he found that sulphuric anhydride acts readily upon potassium sulphate at ordinary temperatures, a fact about which chemical literature contains conflicting views. R. Weber employed a closed tube and a high temperature. The author, on the other hand, found that the dry sulphate absorbs sulphuric anhydride with a considerable evolution of heat. The experiments were made with rectified sulphuric anhydride and 20 to 50grm. of finely powdered sulphate. The sodium, ammonium silver and thallium salts absorb the anhydride with even greater energy than potassium sulphate. In order to completely convert the sulphate into pyrosulphate, a higher temperature was necessary, the method employed being to soak the sulphate with the anhydride and distil off the excess at 100° to 120°. It is doubtful if Weber's octosulphates can be obtained by this method, as at the relatively high temperature employed for eliminating the excess of SO_3, the disulphate was invariably formed. Pure potassium pyrosulphate was prepared in this way. In the preparation of the sodium salt the product contained only 85 per cent. of pyrosulphate. The ammonium, like the potassium salt, can be obtained pure by the above method. Pure disulphate of silver and thallium are formed by simply mixing the sulphates with SO_3. In addition to these barium, strontium, calcium, magnesium, zinc and lead absorb sulphuric anhydride and form pyrosulphates. The purity of the product, however, varies, zinc and lead especially being only capable of taking up a comparatively small quantity of the anhydride. It is quite possible that Weber's method may give the pure compounds. The salts of magnesium and the alkaline earths gave, on analysis, results corresponding to the pure disulphates. The method of Berzelius for preparing pyrosulphates, that is, by heating the hydrosulphates, was next tried, but gave unsatisfactory results. A better method is to heat sulphates with chlorosulphuric acid. Schiff had previously prepared the potassium salt by this reaction—

$$K_2SO_4 + SO_3HCl = K_2S_2O_7 + HCl.$$

Experiments showed that an excess of chlorosulphuric acid is necessary, and this is afterwards distilled off. In this way the sodium ammonium and barium salts are readily prepared.—J. B. C.

Action of Ferric Oxide on Sulphates at a High Temperature. Scheurer-Kestner. Compt. Rend. 99, 876, 877.

WHEN two parts of gypsum are heated to a bright redness with one part of ferric oxide, sulphuric anhydride is given off and a mixture of lime and ferric oxide is left from which the lime can afterwards be removed by acetic acid. Probably the mixture first fuses and forms ferric sulphate, which is decomposed when a higher temperature is reached. By mixing 175 parts of gypsum with 100 parts of fluorspar and ferric oxide, the decomposition takes place at a lower temperature (that of a Bunsen burner), and the sulphuric anhydride formed is prevented from being dissociated into sulphurous acid and oxygen. Lead and magnesium sulphates behave in a similar way to calcium sulphate.—S. R.

Action of Lead Hydrate and Silver Oxide on Aqueous Solutions of Sodium Pentasulphide and Sodium Dithionite. A. Geuther. Annalen, 226, 232-240.

AT ordinary temperatures lead hydrate reacts with the pentasulphide in the following way :—

$$3Na_2S_5 + Pb_3O_4H_2 + 2OH_2 = 6NaOH + 12S + 3PbS.$$

Silver oxide reacts in an analogous way, but a secondary reaction, resulting in the formation of a definite quantity of sulphuric acid from the action of the silver oxide on the finely divided sulphur, also takes place. With sodium dithionite, the changes which take place are represented by the following series of equations :—

$$1.—S_2O_3Na_2 + Ag_2O = S_2O_3Ag_2 + Na_2O.$$
$$2.—S_2O_3Ag_2 = Ag_2S + SO_3$$
$$3.—SO_3 + Na_2O = Na_2SO_4.$$

From these reactions the author considers that the name dithionite should be given to $Na_2S_2O_3$, as the name thiosulphate conveys the idea that the oxygen has been replaced by sulphur.—S. R.

Preparation of Hydrochloric Acid free from Arsenic. H. Beckurts. Arch. Pharm. 22, 684.

COMMERCIAL hydrochloric acid said to be free from arsenic contains generally distinct traces, and cannot therefore be used in judicial chemical cases. The acid, however, can be easily purified by distillation with ferrous chloride, all the arsenic coming over in the first portion of the distillate and more readily if the acid is concentrated. A solution of ferrous chloride is added to a 30 to 40 per cent. acid, the first 30 per cent. of the distillate contains arsenic and the remaining 60 per cent. is collected separately, and is quite pure. In this way a 20 to 30 per cent. acid is obtained. This method can be used technically for preparing hydrochloric acid free from arsenic. Further, arsenic can be detected when present in small quantities, by distilling with ferrous chloride and testing the first portion of the distillate.—J. B. C.

Improvements in the Treatment of Sulphate of Ammonia, for obtaining the Ammonia in the Free State and utilising the Sulphuric Acid. E. Carey, H. Gaskell, jun., and F. Hurter. Eng. Pat. 2118, Jan. 25, 1884.

THE object of this invention is accomplished by mixing intimately sulphate of ammonia and sulphate of soda, in equivalent quantities, and heating the mixture to the point of fusion. Super-heated steam is then introduced into the fused mass. At about 500° F. a decomposition begins, by which free ammonia and hydrogen sodium sulphate (bisulphate of soda) are produced. To hasten the reaction the temperature is gradually raised to from 700° to 800° F. The operation of heating is best carried on in a revolving cast-iron cylinder, heated outside by an open fire. The steam is admitted through a hollow agitator shaft, which rotates in the cylinder, the steam assisting the agitation at the same time. The ammonia set free by this treatment passes away from the cylinder, together with the steam, through an apperture in the cylinder, and is conveyed by pipes into condensers. The steam hastens the reaction by removing the ammonia from the charge as soon as liberated. If steam be admitted before the fusion of the mixed salts, too much sulphate is volatilised as such. The volatilised sulphate is absorbed in water and used over again. By the introduction of the steam into the fused mass, the formation of pyrosulphate is avoided. The pyrosulphate of soda decomposes ammonia producing nitrogen, consequently

causing loss of ammonia. The bisulphate of soda produced in this process is proposed to be used for the decomposition of common salt, and for the production of hydrochloric acid.—C. C.

Improvements in and appertaining to the Manufacture of Sodium Bicarbonate. L. Mond and G. Jarmay. Eng. Pat. 2996, February 9, 1884.

DESCRIBES a method for converting the sludgy precipitate of bicarbonate of soda, obtained by the ammonia-soda process, into a more granular material, to facilitate the removal from it of ammonia and other impurities. For this purpose the crude salt is dissolved in warm water of about 60° C. and the solution allowed to cool, pure bicarbonate separates and all the ammonia remains in solution. The operation of cooling the solution of bicarbonate is varied, in the well-known manner, according to the size of grain desired to be obtained for the crystals. The mother-liquor is separated from the crystals by centrifugal machines. The solution of the crude bicarbonate of soda is best effected under pressure in an atmosphere of carbonic acid. A higher temperature may be employed in this case without decomposing the bicarbonate, but the solution requires to be cooled down to 65° C. before being run off. The mother-liquors may be used several times for washing and dissolving fresh crude salt.—C. C.

Improvements in and Relating to the Manufacture of Salt from Brine. G. S. Hazlehurst. Eng. Pat. 3015, February 9, 1884.

ACCORDING to this specification common salt is precipitated from brine by the addition thereto of chloride of calcium or of any other innocuous salt more soluble than common salt. If the solution of precipitant be hot and strong, salt of a fine grain is precipitated from the brine, if cold and of only slightly higher specific gravity than the brine, salt of a coarser grain is obtained. The salt is freed from the precipitant by washing. The liquid is reconcentrated and used over again for the same purpose. —C. C.

Improvements in the Treatment of Sulphurous Oxide in the Manufacture of Sulphurous Acid (H_2SO_3), Sulphites or Bisulphites. H. E. Scholefield. Eng. Pat. 3059, February 11, 1884.

CONSISTS in the application of an injecting apparatus for drawing off the sulphurous anhydride from sulphur burners or pyrites burners, and forcing it through coolers, and through scrubbers and washers (to remove arsenic and other impurities), into the absorbing apparatus. The injector may be worked by steam, air, or some other gas. The SO_2, after being cooled and after the condensation of the steam accompanying it, passes into the absorbing vessels, in which it is taken up by water to which lime or other alkaline oxide, or hydrate, has been added. For the absorbing vessel a high column may be used and the basic material fed in at the top, and extracted at the bottom fully sulphited. If sulphites are wanted no water is used, but the gas is passed through shallow layers of the alkali or alkaline earth. —C. C.

Improvements in the Manufacture of Bichromate of Soda. W. J. Chrystal. Eng. Pat. 4028, February 27, 1884.

FOR the purpose of manufacturing bichromate of soda free from other salts of soda, the inventor evaporates the solution, which is obtained by adding to the solution of neutral chromate of soda the necessary quantity of sulphuric, muriatic, carbonic, nitric, acetic, or other acid, until the respective salts of sodium—viz., sulphate, nitrate, chloride, carbonate, etc.—are salted out and eliminated. The solution then contains only bichromate of soda, which crystallises out on cooling. The composition of the crystals is represented by the formula—

$$2Na_2Cr_2O_7 + 5H_2O.$$

By evaporating the solution of bichromate beyond the point at which the other soda salts are eliminated, crystals containing less water may be obtained. By evaporation to dryness and subsequent fusion, bichromate of great purity is obtained.—C. C.

Improvements in the Manufacture of Bichromate of Soda. C. S. Gorman. Eng. Pat. 4198, March 1, 1884.

250 PARTS by weight of chrome iron ore, 80 parts of chloride of sodium, 100 parts of sulphate of soda, and 250 parts of hydrated lime are placed in a furnace and subjected to the action of steam superheated to from 1000° to 1600° F. The hydrochloric and sulphurous acids evolved are conveyed to condensers. The finished charge in the furnace is treated in the usual manner. To the chromate of soda solution sulphuric acid is added to convert the same into bichromate of soda. The solution is then placed in coolers, chloride of sodium and sulphate of soda separate out on cooling. After this the solution is evaporated, the evaporation being completed by blowing air heated to from 400° to 700° F. into the liquid.—C. C.

Improvements in the Manufacture of Bichromate of Soda. C. S. Gorman. Eng. Pat. 4929, March 15, 1884.

IN this invention neutral chromate of soda is treated with hydrochloric acid gas. The neutral chromate of soda is converted thereby into bichromate, and the chloride of sodium formed at the same time is thrown down as insoluble and separated from the liquid, thus saving evaporation of the bichromate solution.—C. C.

Improvements in the Manufacture of Cream of Tartar. F. Wirth. Eng. Pat. 4362, March 4, 1884.

THE object of this invention is the production of cream of tartar direct from crude tartar or argol. The argol is dissolved in boiling water or mother-liquor, to which about 15 per cent. (of the weight of argol) of phosphoric acid is added. The solution is then decolourised with animal charcoal or the like, and cleared by the addition of pipeclay. To remove the small traces of iron, copper and other bodies remaining in the clear solution, a small amount prussiate of potash ($\frac{1}{2}$ to 1%) is added, after which the solution is allowed to settle. The clear solution is then allowed to crystallise, and yields large, bright, colourless, almost chemically pure crystals. The mother-liquor is used for dissolving fresh quantities of argol, and the quantity of phosphoric acid which has disappeared from the same (by having formed precipitates of iron and alumina in the previous operation) has to be replenished.—C. C.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Machinery for and Method of Preparing Potters' and other Clays. J. H. Key, Newton Abbot. Eng. Pat. 2538, February 1, 1884.

THE various kinds of clay to be operated upon are first dried in the usual manner and then placed in the desired proportions in the different removable divisions of a wooden shoot, leading to a wooden box, furnished with corresponding removable divisions, and with a hinged bottom divided into two or more parts. This box or truck receives the clays, and is then drawn up an incline, by means of a rope or chain winding upon a drum, to the top of a machine for breaking up the clays. This is provided with an ordinary hopper, in the middle of which is a revolving vertical shaft carrying knives. The bottom of the truck falling, the clays drop through an opening near the top of the incline into the hopper, where they are mixed together and the lumps broken up. The clay broken by the knives falls on to a horizontal screen, made of perforated steel bars, parallel and very close to each other, on which it is crushed small by rollers attached to the vertical shaft and covered with rubber or other elastic material. When crushed sufficiently small, the clay is swept from the surface of the screen into a sifter by series of movable brushes and scrapers, also attached to the shaft and capable of being set to any

angle. The sifter consists of an upper and second sieve of wire-gauze, placed in an inclined position and shaken by cranks connected with a horizontal shaft. The finer particles of clay pass through both sieves and fall into a trough beneath, from whence they are conveyed by a revolving worm to the pugmill. The coarser particles, together with the coarse impurities, are caught by the upper or first sieve, and fall into a water tank, where the impurities separate to the bottom, and from which the clay and water are pumped into a "water-sifter." The water-sifter also receives the smaller particles of clay and impurities caught by the second sieve. Two or more sieves of wire-gauze and graduated fineness, working in water, in an inclined position, constitute the water-sifter, by means of which the coarser particles of clay are reduced to a fine state of division, and the remaining impurities finally separated. The "slop" clay is now raised by a pump or elevator to the revolving worm, along which it passes for a short distance, partially mixing with the dry powdered clay, and from thence to the pugmill.—E. G. C.

Improvements in the Manufacture of Imitation Stained Glass for Decorative Purposes. W. Cunliffe, Hornsey. Eng. Pat. 5080, March 18, 1884.

THE objects of this invention are to overcome the various defects in previously devised methods of imitating stained glass, and to produce a "permanent and perfect substitute" at a very small cost. The required designs are executed in colours or monochrome, upon thin unglazed tracing paper or some other suitable medium, which is then saturated with a solution of bichromate of potash, chrome alum, or other chromate, with a gelatinous solution, as of glue or gelatine, and with a solution of shellac, mastic, or other gum, in turpentine or spirits of wine. The tissue is then thoroughly dried and placed between two adjacent sheets of glass, which are firmly held in position and subjected to a "gentle and gradual heat until the proper point of cementation is reached." When cold they firmly adhere together and are free from all air-bubbles and drops of liquid between the glass and tissue. The finest transparent colours in tubes, such as carmine, ultramarine, Prussian blue, raw and burnt sienna, Vandyke brown, etc., are preferred; but the aniline colours and others may also be used effectively.—E. G. C.

Method of and Apparatus for Drying China, Clay, and similar Materials. J. Lovering and J. Bell, St. Austell. Eng. Pat. 6252, April 10, 1884.

ACCORDING to this invention, a chamber is constructed of any desired length, width, and depth, and perfectly air-tight except at its top, which top forms the drying pan, and is composed of porous tiles or specially formed bricks, which are laid upon iron bars placed transversely over the air-chamber. The tiles are from 12-24in. long, about 4in. thick, and they vary in breadth as may be desirable; they are cemented or otherwise secured together. If bricks be used, they are about 1ft. long, 2½in. wide, and 6in. deep; their sides are vertical for about 2in. down, and are then bevelled off, so that when two bricks are placed side by side there shall be a wedge-shaped space between them open to the air-chamber. The bricks are placed end to end on the bars, the ends being cemented or otherwise secured together; but the sides must be made to fit together accurately, no cement or other material being placed between them. Into the air-chamber so formed heated air is forced by any convenient means. It finds its way through the porous tiles or the crevices between the bricks, and through the wet clay placed on the pan to be dried, thereby driving off the moisture, and effectually and speedily drying the clay. If desired, cold air may be forced into the chamber and there heated. By the use of the apparatus described clay will be dried much more quickly than by the usual method and without any risk of burning.—E. G. C.

Improvements in the Manufacture of Potters' Ware. J. & J. F. Maddock. Eng. Pat. 5460, March 26, 1884.

THIS invention consists in the manufacture of earthenware, china, and porcelain from plastic clay by means of plaster of Paris moulds incased in metal rings or cases, by pressure.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Kilns and Ovens for Economically Burning Limestone, Bricks, and Pipes, etc. H. Hargreaves, W. Beckett, and W. Cliff, Chester. Eng. Pat. 2368, Jan. 30, 1884.

THE exhaust heat from ordinary lime-kilns is applied and utilised by passing it through flues into an oven or kiln, in which limestone, bricks, and pipes of a very superior quality can be burnt without fuel of any description. The ordinary open kilns are covered with fireclay slabs placed in iron frames on wheels running upon iron rails placed on each side of the open mouth of the kilns. "This process does away with any possibility of nuisance from smoke or fumes arising from the process of burning limestone, etc.," and the application of the covers, flues, and chimney to the old kilns was found by the inventor to result in a saving of 20 per cent. in fuel, the new oven not requiring any fuel.
—E. G. C.

Manufacture of Bricks, Paving Blocks, and the like from Blast Furnace Slag or Scoria. G. Patchett, J. Dixon and R. Teasdale, Durham and York. Eng. Pat. 3839, February 2, 1884.

THE kilns in which the bricks, etc., are annealed are constructed with converging or sloping bottoms, and are arranged side by side in a circle or part of a circle, so that all the kilns of the series are situated under the rim of a wheel carrying the moulds or boxes for moulding the molten material. The moulds are provided with a flange or lip overlapping the space between every two consecutive moulds or boxes, in order that waste of slag or scoria may be avoided as far as possible.—E. G. C.

Improvements in the Manufacture of Bricks from Wet Clay. C. and W. Cooper, Great Crosby. Eng. Pat. 3737, February 22, 1884.

ACCORDING to this invention, a column of clay issuing from the mouth or die of a pugging mill is cut by suitably arranged wires into blocks for burning into bricks, the machinery by which this is effected being so constructed that the wires descend through the clay at the same time that the latter is forced horizontally through the range of wires. The clay is thus sawn through, as it were, instead of being cut or torn apart, and the surfaces produced are smooth and even.—E. G. C.

Improvements in the Manufacture of Artificial Lithographic Stones. F. Wirth, Frankfort-on-the-Main. From Louis Rosenthal, Frankfort-on-the-Main. Eng. Pat. 3808, February 23, 1884.

THE disadvantage attending the use of cement for the preparation of plaster, artificial stone, etc., has hitherto been the liability of the material to crack, in consequence of contraction produced by change of temperature. The admixture of sand with the cement has been found to answer for ordinary purposes, such as plastering walls or casting stone blocks, but not for polished surfaces or for imitation marble. This invention is claimed to offer the possibility of making artificial lithographic stones "equal in every respect to the natural ones, and in some respects superior, as they can be made to any required form." The process by which such a homogeneous cement-mass is to be produced is as follows: One half, or rather more, of the cement to be worked is made into a paste with water, and formed into thin plates, which are allowed to harden as quickly as possible, by the aid of heat if necessary. The hardness is increased by repeatedly moistening the plates with water and heating them until

they appear full of cracks in consequence of the sudden changes of temperature to which they have been subjected. These plates are then ground to a fine powder and thoroughly mixed with the remaining portion of fresh unset cement. The mixture is transferred to a cast-iron mould of the desired shape, and therein exposed to a pressure of more than 20 atmospheres; the mould is divided into two compartments by a horizontal perforated plate covered with linen cloth. The quantity of water necessary to set the whole mass is now poured over it, and the air is exhausted beneath the perforated bottom by means of an air-pump or other convenient apparatus. In this way the water is sucked through the mass, all the air being removed and its place filled by the turbid fluid. Excess of water is eliminated, and the particles of the mass are caused to approach one another more closely by a second application of more than 20 atmospheres' pressure. Finally, a liquid containing in solution the alkaline and soluble constituents of cement, is prepared by agitating cement with 100 per cent. of water and pouring off the fluid containing the soluble portions. This liquid is forced through the solidified and hardened stone until "the most microscopic bubble holes are filled out by the soluble constituents contained in the water." The inventor states that repeated experiments have proved impressions taken from the artificial stone so prepared to be sharper than those taken from the natural Solenhofer stone. Such artificial lithographic stone requries no especial treatment with regard to applying colours or causticising, etc. The explanation of the effect of an admixture of already hardened cement with fresh unset cement in preventing shrinkage, is not clear, but it would appear that, by the addition of the former to the latter, a compound is formed which possesses less shrinking qualities than the cement by itself. Finely ground carbonate of lime can be substituted for the already hardened cement.—E. G. C.

Apparatus for Treating Clay to be used in the Manufacture of Bricks, Blocks, Tiles and Terra-Cotta. T. H. Sharpe, Ruabon. Eng. Pat. 4249, March 3, 1884.

The object of this invention is to beat, cut, pulverise and reduce clay, as dug from its bed or after preliminary treatment of any usual kind, to a finely divided and pulverulent condition suitable for being at once shaped into any desired article. This is effected by an apparatus constructed with a series of beater knives revolving past each other in opposite directions.—E. G. C.

Improved Apparatus to be used in the Manufacture of Cement. J. Watson, Greenhithe and Gateshead-on-Tyne. Eng. Pat. 4879, March 4, 1884.

The object of this invention is to separate flint and other similar hard substances, liable to injure the grinding machinery, from the "slurry" as it passes to the grinding apparatus. This is effected by causing the slurry to flow at intervals through a trough provided with stops or gates, behind which hard or heavy particles are deposited. A trap or well may be constructed behind each stop or gate, furnished with a double slide arrangement, so that deposited matter may be received into the well, and allowed to escape from thence without interruption to the flow of the slurry. The deposition of flinty and other heavy particles can be facilitated by giving a vibratory movement to the trough or passage. —E. G. C.

Improvements in the Manufacture of Cement. F. Ransome, Lower Norwood. Eng. Pat. 6517, April 18, 1884.

In a previous specification (No. 4664, 1878), the inventor recommended a method for the manufacture of cement by the calcination of slag sand with chalk or other calcareous matter. According to this invention the sand and chalk were to be ground, and then calcined together. The inventor now advises the admixture with the slag sand of lime in a caustic or hydrated condition; and for this purpose, spent lime which has been used in the purification of gas may be employed. Sulphur may be removed from the gas lime by adding to the mixture of lime and slag sand a small quantity of coal or coke before calcination. A jet of steam is introduced into the furnace during the ignition. A revolving or rotating furnace is employed, and the mixture, admitted in a state of fine powder, is kept in motion in the furnace; it is thus discharged after calcination in the state of powder, and ready for use without further grinding. —E. G. C.

An Improved Asbestos Compound especially applicable for Use as Boards or Sheathing for Roofings, Wearing Surfaces of Car Brakes, and for Building Purposes. Complete Specification. David Hunter Brandon. From Daniel Austin Brown and Charles Francis Brigham. Eng. Pat. 7304, May 6, 1884.

To prepare the improved compound asbestos, preferably in a fibrous form, is incorporated with oxide of magnesium, and then mixed with chloride of magnesium or any chemical equivalent, and the mass moulded to any desired form. To render the compound lighter, and also to cheapen it, vegetable fibre may be added.—E. J. B.

X.—METALLURGY, MINING, Etc.

Purification of Zinc containing Arsenic. Dingl. Polyt. Journ. 1884, 254, 400.

L'Hote (*Revue Industrielle*) has tested a number of samples of sheet and block zinc, and found all of them to contain arsenic, the quantity varying in the case of sheet zinc from 10·5 to 36 milligrammes per kilo., and amounting only to traces in the case of block zinc. An efficacious and quick method of purification consists in adding to the melted zinc from 1 to 1·5 per cent. of anhydrous magnesium chloride, and stirring it well up with it. All the arsenic is given off in the form of trichloride, and by pouring the metal into water it is obtained in a granulated condition, and perfectly free from arsenic. Contrary to that obtained by purification through melting with potassium nitrate and subsequent distillation, it is readily soluble in sulphuric acid. The same method of purification may be applied to zinc containing antimony.—F. M.

Carbon in Iron and Steel. F. A. Abel. Proc. Inst. Mech. Eng. 1, 1885, 30-57; and Engineering, 35, 187, 188.

Preliminary experiments were made to ascertain whether any characteristic differences could be established in structure or chemical condition between thin discs of steel cut from the same piece, but differing from each other in regard to the treatment to which they had afterwards been subjected. No light was thrown upon the mechanical structure of the different specimens by submitting them to the action of the solvent (a chromic acid solution), specially selected on account of its gradual action. Considerable differences were found to exist between the total amounts of carbon contained in different discs, from one and the same piece of steel, but in the hardened, tempered, and annealed states respectively. The proportion in the annealed steel was comparatively very low, and experiment showed that the reduction in the proportion of carbon, during annealing, was due to the prolonged exposure of the discs, 2·5in. diameter, 0·01in. thick, to heat in contact with, or in close proximity to, the wrought-iron plates between which they were confined. In a particular case the carbon was reduced from 1 per cent. to 0·1 by 24 hours, annealing between wrought-iron plates in a cast-iron box. The action of a chromic acid solution (cold saturated solution of potassium bichromate mixed with one-twentieth its volume of pure concentrated sulphuric acid) on the cold-rolled and annealed discs yielded, in different proportions, a black scaly or spangly substance, which was attracted by the magnet, and which was found to contain, in combination with the iron, an amount of carbon equal practically to the whole amount which had been found to exist in corresponding discs,

in the same cold-rolled and annealed condition. On the other hand, a disc of hardened steel, similarly treated, yielded only a small quantity of dark particles of similar appearance, in admixture with some lighter coloured sediment, and the carbon in this residue amounted only to about one-sixth of the total carbon in this steel. The proportion borne by the carbon to the iron in this particular residue, was found to be decidedly higher than in the spangly residues furnished by the annealed samples. Chromic acid solutions of different strengths were employed in the following experiments; an excess of the solution was always employed. In some cases the steel, about 7grm., was supported on a perforated platinum tray in the upper portion of the liquid, but later perforated glass was substituted to avoid possible galvanic action. In the paper published, 1883 (*Engineering*, vol. 35), the author remarks:—On the whole these results appear to furnish some foundation for the belief that the material separated from cold-rolled steel by the action of a sufficiently dilute solution of chromic acid, contains an iron carbide approximating to the formula Fe_3C, or to a multiple of that formula. These results appear to confirm the view that the carbon in cold-rolled steel made by the cementation process exists, not as simply diffused mechanically through the mass of the steel, but in the form of an iron carbide—a definite product, capable of resisting the oxidising effect of an agent which exerts a rapid solvent action upon the iron through which this carbide is distributed. In the recent report (*Proc. Inst. Mech. Eng.*, above cited), it is stated that on examining a majority of the cold-rolled discs (series A, B, C and F) prepared from the same metal, it was found that variations, in some instances considerable, existed in the amount of total carbon in these. This circumstance much diminishes the value of the results furnished by these series of discs. It was suggested to anneal the discs when held between fire-clay blocks and packed in magnesia, instead of wrought-iron plates and soot, to avoid the decarbonising action shown to be caused by the plates; but no conclusive results were obtained by this method owing to the uncertainty as to the composition of the discs before annealing; further experiments in this direction are desirable. Reference is made to results obtained by F. C. G. Müller, who treated Bessemer steel in the cold with dilute sulphuric acid (one of acid to five of water). After 12 hours the black residue (found to be pyrophoric) was dried in coal-gas and found to contain from 6·01 to 7·38 per cent. of carbon, and Müller regards his "amorphous iron" as being probably Fe_3C. From the numbers given, 20 to 50 per cent. of the total carbon in the steel must have been converted into hydrocarbons. In the author's earlier experiments, with one kind of steel in one condition, when the steel was acted upon by a solution (potassium bichromate solution plus sulphuric acid) containing more than enough acid to dissolve its iron, together with combined oxygen, which was able to greatly diminish the formation of hydrogen, about 90 per cent. of the total carbon was left as insoluble carbide. The ratio of sulphuric acid to bichromate was kept constant, the proportion of bichromate in the solution being varied. Three experiments showed a good agreement both in amount and composition of the carbides left; the fourth showed that there was a limit to the stability of the carbides. In recent experiments the result of varying the ratio of the sulphuric acid to the bichromate was first tried; and then, for the remaining solutions, one uniform ratio (equal weights) between the sulphuric acid and bichromate was maintained. The steel operated on and its condition were also varied. The numbers obtained are put together in the accompanying table, and to a great extent explain themselves.

Method of Experimenting.—The weighed portion of steel (previously cleaned with emery, then with cold ether, and wiped) was dipped into the solution, stroked while moist with the finger, then placed on a glass sieve near the surface of the chromic solution contained in a capacious beaker. In the case of hardened steel much hydrogen was evolved. The solution was probably in all cases complete within 24 hours; the sieve was rinsed into the liquid, the latter stirred up, and allowed to stand for another 24 hours. After decantation and slight washing, some fresh chromic solution was added and shaken occasionally for 24 hours at least. After decanting on to a filter and washing with water, alcohol and ether, the residue was dried over sulphuric in vacuo and weighed. A correction for the small amount sticking to the filter was made by estimating the iron in it. As the amount of sulphuric acid affects greatly the yield of carbide, it was desirable, in the later experiment, to avoid the presence of large quantities. The number given in the table under the head of "free sulphuric acid sufficient for dissolving grams iron," was calculated from the following equations:—

$$(a)\quad K_2Cr_2O_7 + H_2SO_4 = 2CrO_3 + K_2SO_4 + H_2O.$$

$$(b)\quad Fe_2 + 2CrO_3 + 6H_2SO_4 = Fe_2(SO_4)_3 + Cr_2(SO_4)_3 + 6H_2O.$$

The solutions are, however, able to dissolve more iron than this calculated amount. With the exception of one or two darker preparations, which proved to be partly decomposed, all the carbides obtained were grey-black heavy powders, not at all pyrophoric at ordinary temperatures. The unfused cemented (L) Dannemora steel contained: Total carbon, 0·941 per cent.; silicon, 0·006 per cent.; manganese, 0·009 per cent. After experiments 1-5, a second portion gave: Total carbon, 0·913 per cent. Digested with hydrochloric acid, a residue of carbon unconverted into hydrocarbon amounting to 0·018 per cent. was obtained. The products of experiments 2, 3, and 4 are obviously decomposed carbides. The number for "percentage of total carbon in the steel obtained as carbide" is too favourable; the actual carbide is better given by the percentage of iron in these insoluble products. Experiment 4 shows that diluting a solution containing an excessive quantity of sulphuric acid, causes less decomposition of the carbide, but does not give a much improved result in the total obtained. Experiment 6 shows that a large excess of the chromic solution compared with the steel taken can be used without detriment.

Annealed and Hardened Steel.—Eight pieces were cut off, four were annealed in fireclay blocks and magnesia, and four hardened between planed cast-iron plates. The annealed steel contained 1·015 per cent., the hardened 0·995 per cent. of total carbon. The agreement in the amount of carbide obtained in 7 (12·8 per cent.) with the 12·5 per cent. furnished by the much stronger (in chromic acid) solution of 9, is of importance in connection with the experiments with the tempered steel. The three small quantities of carbide from the hardened steel were strongly attracted by the magnet, but there was not enough for analysis. Experiments 13 and 14 were made with discs of series F already mentioned. The halves of three discs were taken for experiment, the other halves were used for estimation of total carbon. In the case of the annealed specimens this estimation was lost, and the mean of three discs previously examined (1·140) had to be taken. The hardened halves contained 1·093 per cent. carbon. The important numbers for carbon, water, and for carbon not converted into hydrocarbons, agree well with the numbers given by the other annealed steels.

Tempered Steel.—The halves of three discs were used for experiment 15, and the other three halves for carbon estimation; and similarly for 16. The straw contained 0·928 per cent., the blue 0·917 per cent. of total carbon. In the repeat experiments 17 and 18, less carbide was obtained than in 15 and 16, it is not easy to see why. A lower yield of carbide from blue- than from straw-tempered steel was also not expected; the hotter blue discs may in some way have been chilled on removal from the tempering bath, considering the small weight and large surface of the discs. Experiments 19-34 were made with 24 discs of fused steel, each 0·01in. thick, and $2\frac{7}{16}$in. in diameter; they were cut from the same strip of steel. The halves of three discs were used for the estimation of total carbon, while the other halves were used for 22 and 23. "Straw, hot chamber 6 hours," gave 1·148 per cent.; and "blue metal bath, 15 minutes," gave 1·120 per cent. total carbon. The steel also contained 0·161 per cent. silicon, and 0·169 per cent. manganese.

Experiments 30 and 34 showed that the addition of water to the solutions did not affect the yield of carbide. The yield of carbide in experiment 22 was 2·52 per cent., which is inexplicable. The low number, 4·61 per cent., obtained in 24 may be set aside. Had these tempered steels behaved like annealed steel in leaving 90 per cent. of their total carbon as a carbide, containing 7 per cent. carbon, the yield of carbide would have been 14·5 per cent. The mean composition of the carbides obtained in the best experiments is given in the following statements, which include the mean of the three given in the report of January, 1883 :—

	Water.	Carbon.	Iron.
Cold-rolled steel, mean of experiments 1 to 6	0·93 %	6·92 %	92·77 %
Annealed steel, mean of experiments 7, 9 and 11	1·32 ,,	7·04 ,,	91·80 ,,
Tempered steel, mean of experiments 25, 26, 27, and 28	2·23 ,,	7·23 ,,	89·92 ,,
Cold-rolled steel, January, 1883, mean of preparations 1 to 3	2·09 ,,	7·12 ,,	90·87 ,,

Probably the greater part of the water in the carbide is present as a constituent of a carbo-hydrate, which is a product of decomposition of the carbide, as this increase in the proportion of water is attended by an increase of carbon and a decrease of iron.

The specific gravity of some of the specimens of carbide, and of the steel from which they had been prepared, is as follows :—

CEMENTED (L) DANNEMORA STEEL.

Specific gravity at 60° F. (Water at 60° F. = 1·00).

Steel cold-rolled	7·75	Carbide from cold-rolled steel	6·9
Steel annealed	7·67	Carbide from annealed steel, Ex. 9	7·2
Steel hardened	7·64	Carbide from annealed steel, Ex. 11	7·2

In estimating the total carbon in the steels by means of copper chloride, it was noticed that the "carbon" was left by the chloride in the following conditions :—By one cold-rolled steel, in a powdery form ; by two annealed steels, in powder ; by one hardened steel, in plates and bulky ; by another hardened steel, in large plates ; by a straw-tempered steel, in bulky plates ; by a blue-tempered steel, in bulky plates.

The author draws the following conclusions from his work :—(1.) In annealed steel the carbon exists entirely, or nearly so, in the form of a carbide of iron of uniform composition (Fe_3C, or a multiple thereof), uniformly diffused through the mass of metallic iron. (2.) The cold-rolled samples were very similar to the annealed steel in this respect. (3.) In hardened steel the sudden lowering of the temperature appears to have the effect of arresting the separation of the carbon, as a definite carbide, from the mass of iron in which it exists in combination, its condition in the metal being mainly the same as when the steel is in a fused state. (4.) In tempered steel the condition of the carbon is intermediate between that of hardened and of annealed steel. The maintenance of hardened steel in a moderately heated state causes a gradual separation (within the mass) of the carbide molecules, the extent of which is regulated by the degree of heating, so that the metal gradually approaches in character to the annealed condition ; but, even in the best result obtained with blue-tempered steel, that approach, as indicated by the proportion of separated carbide, is not more than about half-way towards the condition of annealed steel. (5.) The carbide, separated by chemical treatment from blue and straw-tempered steel, has the same composition as that obtained from annealed steel.

Discussion.

W. H. Dugard observed that Prof. Norris had found that very hard steel would dissolve in sulphuric acid without leaving any residue whatever, while annealed steel left a residue of carbon, exactly in the form of the original steel, and according to the different degrees of hardness so the amount of residue varied.

I. L. Bell on one occasion took a disc of malleable iron containing a mere trace of carbon, and had its surface planed and polished, and also a similar disc, in point of size, made of cast iron, which was also planed and polished. These two discs were screwed together and enveloped in molten cast iron, where they were kept for different periods, from a week to four weeks. He found that, without there being a trace of fusion, the carbon from the cast iron had passed as it were into the disc of malleable iron.

A. Paget remarked that seven of the thin steel discs had been bolted between a cast-iron plate on the one side and a wrought-iron one on the other, and the whole had been kept at a good red heat, short of fusion, for 24 to 36 hours. Judging by practical tests the one nearest the cast iron was the most steely, while the one nearest the wrought iron was least steely, and they followed a somewhat regular gradation from the first disc to the seventh.

Sir F. Abel, replying, said that twenty-five years ago he obtained results similar to those described by Mr. Dugard as having been obtained recently by Prof. Norris.
—J. T.

On the Oxidation of Copper. Debray and Joannis. Compt. Rend. 99, 688.

Copper becomes oxidized by heating it in air from 350° up to a temperature at which the dissociation of the oxide attains a tension of $\frac{1}{5}$ atmosphere, when cupric oxide is formed without passing through the intermediate state of cuprous oxide. Cuprous oxide is oxidized at a moderate heat even more rapidly than metallic copper. At a very high temperature cupric is converted into cuprous oxide.—J. B. C.

On the Decomposition of Copper Oxide by Heat. E. J. Maumené. Compt. Rend. 99, 757.

The author points out that the results of the experiments of Debray and Joannis must be regarded as incorrect, and states that an intermediate oxide of copper exists between cuprous and cupric oxide, having the formula Cu_5O_3 soluble in acids with a brown colour, whereas Cu_2O gives a colourless, and CuO a blue or green solution ; and further that Cu_5O_3 colours glass a brilliant red, Cu_2O producing no change, and CuO a green colour. From his "general theory" the author derives a series of complicated intermediate oxides of CuO and Cu_2O.—J. B. C.

An Improved Method of Manufacturing Metals and Metallic Alloys. John Lewthwaite, Halifax, England. Eng. Pat. 3240, February 13, 1884.

This is an addition to or completion of a former patent by the same inventor (No. 1553, March 27, 1883), and refers to the admixture of titaniferous or other metallic sands or refractory ores of suitable properties with molten metals for the purpose of producing improved or purified metals or alloys. The claim is for the production of a superior class of iron, steel, bronze or other metallic compound by the introduction into the clear molten metal or metals of titanic sand or ore or other ores containing certain mineral acids, such as titanic, manganic, silicic, etc., in a finely comminuted form, in which they are in the fittest state to produce an electro-chemical combination.—B.

Improved Means for Preventing Galvanic Action in Iron and Steel Ships when Protected by Copper or other similar Sheathing ; applicable also to other like Submerged or Partially-submerged Surfaces. B. L. Thomson, London. Eng. Pat. 4658, March 10, 1884.

The iron or steel surface to be protected is coated with a vitreous layer (as of sodium silicate or other materials which will form glass when subjected to the action of heat), to which the sheathing plates are affixed by means of india-rubber solution or otherwise. "A layer of india-rubber or cork, felt, paper or canvas, or the like saturated with india-rubber solution is preferably interposed between the sheathing plates and the surface of the metal to be protected." When the sheathing plates are secured in position the vitreous coating surrounding their edges is heated by means of a blowpipe or otherwise, so that the vitreous material may cover the joints and thus

TABLE OF EXPERIMENTS ON STEEL.

Experimental No.	Description of Experiment (in cubic centimetres)	Bichromate solution (grammes)	H_2SO_4 added per 1 gramme of $K_2Cr_2O_7$ (grammes)	Amount of solution employed: contained grammes of $K_2Cr_2O_7$	Amount of solution employed: free H_2SO_4 (grammes)	Steel taken (grammes)	Second portion of solution used, and weight of steel (grammes)	Carbide obtained per 100 of steel	Percentage of total carbon in the steel obtained as carbide	Analysis of the carbide: weight taken for analysis (grammes)	Per 100 carbide: Iron	Per 100 carbide: Carbon	Per 100 carbide: Loss	Carbide heated with HCl, carbon not converted into hydrocarbons: per 100 carbide	Per 100 carbon of carbide	Experimental No.
1	The [illegible] Cemented [illegible] Steel as received from [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
2		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
3	,,	—	—	—	—	[illegible]	—	[illegible]		[illegible]			[illegible]	[illegible]		3
4	,, (used [illegible] cc. of the solution of Exp. 3 + [illegible] cc. water)	—	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			4
5	,, (used [illegible] cc. of the solution of Exp. 1 + [illegible] grammes H_2SO_4)	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5
6	,,	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6
7	The [illegible] Cemented [illegible] Steel, Annealed	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7
8	,, Hardened					[illegible]		[illegible]		[illegible]		[illegible]	[illegible]			8
9	,, Annealed (Repeat Exp.)	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9
10	,, Hardened (,,)					[illegible]		[illegible]								10
11	,, Annealed (,,)	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11
12	,, Hardened (,,)	—	—	—	—	[illegible]	—	[illegible]	—	—					—	12
13	Steel of Mr. [illegible] — Annealed	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13
14	Hardened	—	—	—	—	[illegible]	—	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			14
15	The Cemented (1) [illegible] Steel, Tempered — Straw Temper	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			15
16	Blue Temper					[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			16
17	Straw Temper (Repeat Exp.)	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							17
18	Blue Temper (,,)	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—						18
19	Fused Steel Tempered [illegible] — Straw, Metal Bath, 15 minutes	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							19
20	,, ,, Hard [illegible]	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—						20
21	,, ,, Soft [illegible]	—	—			[illegible]		[illegible]	[illegible]							21
22	Straw, Hot Chamber, 6 hours	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			22
23	Blue, Metal Bath, 15 minutes	—	—	—	—	[illegible]	—	[illegible]	[illegible]							23
24	Blue, Hot Chamber, 6 hours	—	—	—	—	[illegible]	—	[illegible]	[illegible]							24
25	The same, repeat Experiments — Straw, Metal Bath, 15 minutes	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			25
26	Straw, Hot Chamber, 6 hours	—	—	—	—	[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			26
27	Blue, Metal Bath, 15 minutes	—	—	—	—	[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			27
28	Blue, Hot Chamber, 6 hours	—	—	—	—	[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			28
29	The same, repeat Experiments — Straw, Hot Chamber, 6 hours	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—						29
30	,, ,, ,,	—	[illegible]	[illegible] + [illegible] water	[illegible]	[illegible]	[illegible] + [illegible] water	[illegible]	[illegible]							30
31	Blue, Metal Bath, 15 minutes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			31
32	,,					[illegible]		[illegible]								32
33	Blue, Hot Chamber, 6 hours	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							33
34	,, ,, ,,	—	—	[illegible] + [illegible] water	[illegible]	[illegible]	[illegible] + [illegible] water	[illegible]	[illegible]	—						34

Recalculation according to equations a and b [illegible] of the data of the [illegible] used for Preparations 1–4 [illegible] Mechanical [illegible], January [illegible].

Solution for Preparation 1	[illegible]	0.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
,, ,, Preparation 2	[illegible]	0.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
,, ,, Preparation 3	[illegible]	0.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
,, ,, Preparation 4	—	0.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

produce a perfect junction impervious to moisture. Galvanic action is by these means entirely prevented.
—E. G. C.

Improvements in the Manufacture of Chromium Alloys. Thomas Slater, Bayswater, London. Eng. Pat. 9460, March 21, 1884.

THE object of the inventor is to produce alloys of chromium in an economical manner so as to make them more readily available for use in the arts. He takes chromate of potash or other salt of chromium, or chromic acid, mixes them with an equal weight of charcoal in coarse grains, and heats them together in a covered crucible. When the mass has been softened by heat he pours thereon about two-and-a-half times its weight of molten copper, and further adds from one-half to two parts in weight of molten tin. After thoroughly heating and stirring together for some time the mixture is poured into water for the purpose of reducing or disintegrating the same. The resulting granulated mass is then remelted with a flux of the following composition—viz., one part of biborate of soda, two parts of nitrate of potash and two parts of carbonate of potash, when it is cast into moulds, plates, ingots, etc., for employment in the arts. It will then be found to have a rich golden yellow colour, but if a white alloy be required it can be produced by the addition to the chromium salts or oxides of metallic nickel mixed with tin and with copper in suitable proportions.—B.

A Method of Producing Alloys of Iron or Manganese or Iron and Manganese with Tin. Charles Billington and John Newton, Langport, Staffordshire. Eng. Pat. 5345, March 24, 1884.

THE inventors claim the introduction of iron or manganese, or of iron and manganese not previously alloyed, into a bath of molten tin kept at a suitable temperature, the iron or manganese being connected by wires to a dynamo machine or battery. When put in circuit it is claimed that the current of electricity throws off the iron or manganese or iron and manganese into the tin bath, and produces chemical action between the metals, which causes them to alloy with each other in any desired proportion that can be regulated with great nicety.
—B.

Improvements in the Manufacture of Metallic Alloys. George Alexander Dick, Cannon Street, London. Eng. Pat. 6172, April 9, 1884.

THE object of the invention is to produce manganese copper in a readier and less expensive way than at present. For this purpose pure copper is melted in a crucible with ferro-manganese containing a large percentage of manganese, and in the presence of silicium. When pouring out into ordinary moulds, the manganese will be found to have combined with the copper, and the silicium with the iron, the latter forming a layer upon the manganese copper. The greater the amount of silicium present the more perfect is the separation, though even so small a quantity as 1 per cent. of silicium as compared with the manganese present suffices for the desired effect. In some cases the ferro-manganese contains in itself sufficient quantity of silicium to produce the necessary reaction upon the iron so as to set the manganese free to combine with the copper.—B.

Improvements in the Treatment and Production of Iron, and in the Apparatus employed therefor. Samuel Richard Smyth, Surrey. Eng. Pat. 8583, June 4, 1884.

THE inventor proposes to produce in a single heat, from indifferent materials and with a low pressure of blast, iron of the best quality, ready for the rolling mill or hammer, and dispensing with the usual processes of puddling, etc. For this purpose he first melts the ore in any convenient way, or he re-melts pig-iron and he taps a charge, preferably of about 10 tons' weight, into his improved refining "Manipulator." This consists of a cylindrical body or shell hung in trunnions mounted on its axis, and supported on a cradle-truck, which is carried on wheels. The shell is lined with any suitable material of a refractory nature, such as, for instance, a compound consisting of 96 parts of silica, about 2·3 parts of alumina containing some iron oxide, and about 2 parts of plumbago wetted moist and hand rammed. It is fitted with gear for rotating, and has an external chamber or box with movable cover, into which liquid compounds, air, gases, and other elements in a sub-divided state, are forced through holes in the refractory lining after entering through a central aperture in the shell and passing an internal chamber, which communicates with the external one. The charges, when finished, are withdrawn through a tapping hole. The liquid compounds spoken of above as forced into the metal are chlorine compounds, carbon and hydrogen compounds and oxyhydrogen compounds. These are first minutely sub-divided or "atomised" in an apparatus hereafter described, and are carried forward into the body of the metal in the manipulator by either atmospheric air or other gases, which may either serve as carriers only or may be used partly for chemical action in combination with the atomised liquids. The "Atomiser" for preparing the liquid compounds and conveying the air gases into the metal, consists of a horizontal vessel or reservoir, to which the blast is connected at one end and an outlet provided at the other. Upon the reservoir are fitted three or more cylindrical upright tanks, each connected with it through a pipe and valve. Another pipe is tapped to the top of each tank, and reaches on the inside nearly to the bottom. These latter pipes convey the liquid to atomising injectors and to a mixing box, whence the mixture passes through a connecting pipe and valve into the external chamber of the manipulator previously referred to. There are also gauges, valves, floats, and supply pipes to regulate the quantity of the various liquids admitted to the tanks. Absorbents of carbonic oxide or of iron oxide from the charge of metal may be added to the charge in the manipulator as required, and it may also be stirred with wood poles for absorbing the oxygen, similar to what is practised in the manufacture of copper. When the treatment of one charge is completed the manipulator may be removed on its truck, and another previously filled with molten metal substituted for it, thus making the operation continuous. A sheet of drawings representing the manipulator and the atomising apparatus accompanies the specification.—B.

Improvements in the Extraction of Cobalt, Nickel, and Manganese from their Ores, and of Nickel from its Ores, when such Ores are found in a similar condition to those of New Caledonia. Henri Herrenschmidt, Bondi, near Sydney, N.S.W. Eng. Pat. 12,044, September 5, 1884.

THE patentee deals with the extraction of metal from two kinds of ore found in New Caledonia—viz., the manganiferous ores of cobalt and nickel, and the plain ores of nickel. Where both kinds of ores are to be treated at the same place, the manganiferous ore is first manipulated by placing it in a solution of proto-chloride of iron, and heating to boiling, when the cobalt, nickel, and manganese will dissolve. From the solution the cobalt and nickel are precipitated by the addition of a sufficient quantity of sulphide of manganese or hydrated oxide of manganese. The supernatant liquor being a solution of pure chloride of manganese, is either crystallised for marketable purposes, or evaporated at a moderate heat, whereby hydrochloric acid is driven off, and oxide of manganese obtained as residue. The plain ores of nickel are now treated with the hydrochloric acid by heating the latter, and using it as a bath for these ores until the complete dissolution of the nickel, which is then precipitated from the solution as before. Or the hydrochloric acid obtained as above may be used for the production of proto-chloride of iron for the treatment of the manganiferous ores, and thus the process carried on in a continuous round of operations involving very little loss.—B.

Improvements in the Process of working Auriferous and Argentiferous Arsenides and Sulphides of Iron, Copper, or other similar Substances by Litharge or Lead. Edward Probert, San Francisco, California. Eng. Pat. 15,057, November 15, 1884.

THE invention relates to an improved method of stirring the molten materials in the process of working auriferous and argentiferous arsenides and sulphides of iron, copper, or other similar compounds in which litharge or lead is introduced for the purpose of extracting the precious metals. The improvement consists in a novel mode of stirring the materials by means of elastic vapour generated by the action of the molten mass upon substances placed within the melting pot, and without the aid of mechanical stirring. The inventor takes iron pots of conical shape and lines them inside with a refractory material worked in the plastic state. He then places upon the bottom a further lining of suitable thickness, composed of mineral carbonates, mixed with a sufficient quantity of the original lining material to give it consistency. After being slightly dried for the removal of the excess of water the pots are ready for use. When the molten material from the furnace is tapped into the pot, and simultaneously therewith or immediately after the charge of litharge or lead, the evolution of steam and carbon dioxide causes a considerable and very regular ebullition and agitation of the materials, with the effect of inducing an intimate mixture of the ingredients. The duration of the action can be regulated to suit the quantity and the heat of the molten mass, as well as its composition, by altering the thickness and the composition of the calcareous bottom. Other means than that described may be used for holding the calcareous materials to the bottom of the pot within the molten mass.—B.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

A New or Improved Process for the Separation of Glycerine from Fatty Substances. C. Rumble and F. Sear. Eng. Pat. 4264, March 1, 1884.

ZINC or magnesium salts of fatty acids are first prepared by boiling together in an open vat with free steam, dilute alkaline solution, fatty substances, and zinc or magnesium sulphate. The fatty substance to be deprived of its glycerine is then heated with one-third its weight of water, and from 5 to 8% of the zinc or magnesium salt of fatty acids, to a steam pressure of 120 to 130lbs. per square inch, and a temperature of 368° F. The glycerine is separated from the "sweet water" in the usual way, and the zinc or magnesium soap may be decomposed by a mineral acid, the salts so produced being employed over again.—W. L. C.

An Improved Method or Process of, and Apparatus for Recovering Paraffin, Stearin, or similar Wax-like Substances from Petroleum or other Oil. Communicated by Rollin H. Smith, Pennsylvania, to H. H. Lake. Eng. Pat. 13,579, December 15, 1884.

THE usual mode of separating the solid constituents of oils from the liquid ones, is by filtration or by pressure, heavy hydraulic presses being usually employed. The patentee proposes to effect the same object by spraying the oil upon a travelling blanket, which afterwards passes between pressing rollers; the oil is squeesed out, and the solid portions, which are left on the belt, are removed from it by a scraper, and carried away by a travelling belt. The process is rapid and continuous, but requires very close attention to the temperatures of the room, and of the oil. The spraying apparatus is a pipe furnished with a number of "bib-cocks."—W. L. C.

Improvements in Lubricating Compounds. Communicated by D. D. Wass, of New York, to A. M. Clark, London. Eng. Pat. 5901, December 30, 1884.

THE patentee mixes 1lb. paraffin with 1lb. mineral oil and $\frac{3}{10}$lb. of alcohol. $\frac{1}{20}$lb. of powdered talc is well stirred in. The mixture when cold is pressed and made into cakes, balls, or "cartridges," which are dipped into melted paraffin, and thus become covered with a protecting shell of paraffin.—W. L. C.

Improvements in the Manufacture of Soap. C. R. Alder Wright. Eng. Pat. 14,681, January 12, 1885.

DR. WRIGHT proposes to counteract the evil effects on the skin or on fabrics, of the free caustic soda or potash often to be found in soap, by mixing with the soap some ammoniacal salt (usually sulphate or chloride), the acid of which combines with the free caustic alkali, while the liberated ammonia gradually passes away into the air during the subsequent operations of cutting, stamping, etc. Even if a little free ammonia remain in the soap, it is not nearly so deleterious as the fixed alkali.—W. L. C.

Improvements in Obtaining Glycerine and Fatty Acids from Animal and Vegetable Substances. J. W. Freestone. Eng. Pat. 7573, February 10, 1885.

THE fat is heated in an autoclave for four or five hours at a pressure of 100 to 125lb. per square inch, with one-half its volume of water, and from $\frac{1}{2}$ to 1 per cent. of hydrated oxide of magnesium, prepared by precipitating magnesium chloride with milk of lime or caustic soda, and washing the precipitate. The mixture of fatty acids and magnesic soap may be at once saponified, or treated first with a mineral acid.—W. L. C.

Improvements in Extracting Grease from Soap-water, and its Subsequent Bleaching and Purification. Benjamin Davy. Eng. Pat. 4679, February 23, 1885.

THE soap-water in calico printing works is treated, in tanks at 50° F. or upwards, with sulphuric or hydrochloric acids; the clear liquid is decanted, and the fat separated by filtration. The fat is then hot-pressed, and the grease from the hot-presses is clarified and bleached with "sulphuric or hydrochloric acid and common soda."—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Rubber Compositions. J. J. C. Smith, Passaic, N.J., U.S.A. Eng. Pat. 15,150, November 18, 1884.

THIS specification relates to the production of a vulcanisable composition of india-rubber or caoutchouc combined with ozokerit, mineral wax or paraffin and sulphur. The ozokerit is first melted with rosin, and the caoutchouc and sulphur are added, the mixture then being removed to a regular rubber mill, after which it is ready for working into articles in the same manner as other rubber compounds. The inventor states that by the addition of rosin, together with ozokerit, a perfect union of the rubber and sulphur with the mineral wax is effected, and a much stronger and more elastic composition produced.—E. G. C.

Improvements in the Manufacture and Preparation of Drying Oils. Miles Williams, Wigan. Eng. Pat. 579, January 3, 1884.

ACCORDING to this invention, a drying oil "medium" for paints, etc., is prepared by distilling colophony in an iron still. Pyroligneous acid and water first pass over, and the temperature is maintained at 315-320° F. until the resin is freed from these compounds. The temperature is then raised, until the resin boils and crude resin oil distils over. The oil, if required to be very pale, is rectified by redistillation, or by being heated for about ten hours to a temperature of about 300° F., and is finally mixed with a suitable dryer, such as the oxides of lead, manganese, etc. The resulting oil is transparent, free from bloom, has good drying properties, and forms a hard, tough, glossy surface, which, when dry, does not contract or crack. It moreover possesses a sweet smell, and will mix in any proportions with other boiled and drying oils; it is soluble in turpentine, and is a good solvent for gum-resin or varnish gums.—E. G. C.

An Improved Mode of Treating Certain Resins for obtaining a New Elastic Substance. A. Germot and L. Rivière, Paris. Eng. Pat. 2630, February 2, 1884.

As the result of numerous experiments, the inventors have proved that oleic acid from stearin works will entirely dissolve solid and semi-solid resins. The degree of solubility varies with the nature of the resins to be dissolved, and the temperature required from about 50-150° Centigrade. The product of the solution thus effected is soluble in spirits of turpentine and in oil, and can, therefore, be used for the manufacture of oil varnishes. Solid and semi-solid gums are also soluble in ethylic and benzoic aldehyde, liquid or melted camphor and chloroform. "The solution of gum in the above-named aldehydes, and liquid or melted camphor and chloroform forms an elastic material, having equivalent properties to those of the material (elasteine) produced by the solution of the gums in oleic acid. The integral solution of copal gums in oleic acid (effected in a similar manner to that hereinbefore described) gives a product which is applicable not only to the manufacture of varnishes, but also of new plastic materials. Products varying in consistence may in fact be obtained by altering the proportions of the oleic acid and gum, as well as by varying the kind of gums employed." The product of the solution of the gums in oleic acid has sometimes the elasticity and consistence of india-rubber, and the inventors have given to this substance the name of "elasteine." It is suitable for the manufacture of varnishes, of coatings of all kinds for cloth, wire, etc., and for making insulating cloth by the incorporation of cork, fibrous or textile material, or mineral substances, with the elasteine. The ordinary process of dissolving solid and semi-solid copal resins in oil and in spirit of turpentine is somewhat dangerous and difficult, and it has to be carried out at a temperature at which about 25 per cent. of the resin to be dissolved is lost. This loss of resin is avoided if the inventors' process be adopted.
—E. G. C.

Manufacture of Weatherproof Oil Colours or Paints. Otto Wolf, Saxony. From August Then Bergh, of Dresden. Eng. Pat. 2896, February 7, 1884.

A PROCESS for making oil colours or paints which are to be employed in cases where such preservation is deemed necessary. "Oil colours or paints have up to the present time not been manufactured with sufficient care." "The process of the conversion of the oil varnish into a resinous substance, and the facilitating of the said process so as to prevent the penetration of dampness, has not received sufficient attention; and, on the other hand, the hardening of the colour or paint by adding exceedingly hard substances has been overlooked, but is necessary to enable the colour or paint to withstand the injurious effects of the continuous friction of rain, dust, and sand." The inventor adds to the oil varnish a powder consisting of ground and calcined lead or silver slag, which is a very hard material. The said substance contains about 25 per cent. of SiO_2 and small quantities of

PbO, ZnO, SnO_2, FeO, CuO, Al_2O_3, MnO, $CaSiO_3$, and S.

"The said substance contains the above in such favourable proportions for the preparation of weatherproof oil colours, that in the opinion of competent experts, the so prepared oil colours or paints, with the addition of burnt colours in the various requisite shades, are perfectly able to withstand dampness and all atmospheric influences or effects of the weather, as the resinous process is not only facilitated by the addition of the aforesaid silicic compounds, but the paint or colour is also rendered hard or indestructible."—H. A. R.

Priming and Anti-fouling Compositions. P. Layden and W. McLean, Jarrow. Eng. Pat. 4796, March 12, 1884.

THE priming composition of the inventors consists of the following ingredients :—

1. Gum guaiacum in powder	3 parts.
2. Teak varnish	3 „
3. A varnish known as knotting varnish	2 „
4. Yellow resin or other resinous gum	12 parts
5. Benzoline or other spirit	20 „
6. Stockholm or other tar	5 „
7. Black varnish	5 „
8. Colouring matter	30 „

No. 4 is reduced to a fine powder and dissolved in part of No. 5; Nos. 1 and 3 are then thoroughly mixed together; Nos. 2, 6, 7, and 8 are next placed in a properly constructed mixing vessel, to which are lastly added gradually Nos. 1, 3, 4 and the remainder of No. 5. The whole is then briskly stirred for twelve hours, at the expiration of which period the composition is ready for use. The anti-fouling composition is prepared from the following ingredients :—

1. Metallic bronze powder, known as gold bronze powder	1 part.
2. Gum catechu in powder	5 parts.
3. Teak varnish	7 „
4. Schweinfurt or Vienna green	3 „
5. Yellow resin or other resinous gum	15 „
6. Benzoline or other spirit	30 „
7. Stockholm or other tar	5 „
8. Black varnish	6 „
9. Pure Prussian blue	3 „
10. Colouring matter	37 „

Nos. 2, 3, and 4 are thoroughly mixed together; No. 5 is reduced to a fine powder and dissolved in part of No. 6; Nos. 1, 7, 8, 9, and 10 are next placed in a mixing vessel, Nos. 2, 3, 4, and 5 and the rest of No. 6 being then gradually added. The mixture is now briskly stirred for a period of twelve hours, after which it will be ready for use. The compositions may be applied to surfaces with a brush in the ordinary manner; the anti-fouling is applied when the coating of priming has dried.
—E. G. C.

Improvements in the Preservation of Moist Colours. H. F. Brousson. Eng. Pat. 4778, March 14, 1884.

THIS invention relates to a simple device for protecting the contents of the pans in which artists' moist colours are kept from becoming dry by exposure or useless through dust, etc.—H. A. R.

Improvements in the Manufacture of Red Pigments or Paints. John Cowdery Martin. Eng. Pat. 5192, March 20, 1884.

THE improvements consist in treating red oxide of lead, or the oxide known as "orange lead," or a mixture of these, with white lead, as follows:—Inventor treats with a weak solution of carbonate of soda or potash, the quantity of alkali being from 1 to 2 per cent. of the other materials. Either acetic, nitric or other suitable acid, or else acetate or nitrate of lead is added in quantity sufficient to neutralise the alkali used, and the mass, which has assumed "a brilliant vermillion tint," is dried. The red colouring used other than lead compounds is that known in commerce as "aniline scarlet," and the proportions of lead compounds and "aniline scarlet" vary according to the shade required. The lead compounds are made into a thin paste with water, the alkali added in solution, and the whole heated in a pan. After addition of the other ingredients, and when a thick paste has been formed, the colour is dried in a stove. The pigment resulting is ground into an oil paint in the ordinary way. Red pigments, termed "vermillionettes," are made by combining eosine with white lead and "white zinc," "but the colour of this material is extremely fugitive, and pigments made with it partake of this character." "The colour produced as above does not fade, and resists as an oil-paint long exposure to atmospheric influences equally well with genuine vermillion."—H. A. R.

Improvements in the Production of Compounds containing Nitro-Cellulose, suitable as Varnishes, and for making Leather Cloth. William Virgo Wilson and Joseph Storey. Eng. Pat. 6051, April 7, 1884.

THE inventors claim the use of acetate of amyl as a solvent for nitro-cellulose. Such a solution can be used as a varnish for an infinite variety of articles. When 200 parts nitro-cellulose are mixed with 600 parts acetate of

amyl a mass of a doughy consistency is obtained, which can be used for any of the purposes for which celluloid is used. With the addition of castor oil, China clay, and a small proportion of certain essential oils, a compound suitable for the production of artificial leather may be produced.—E. J. B.

Improvements in the Manufacture of Euphorbia Paints. S. R. Hooper. Eng. Pat. 39, Jan. 1, 1885.

In the utilisation of euphorbia juice with pigments it has been the practice simply to mix the same with ordinary paints. The said juices become more or less dissolved out or impaired by moisture, and thus the paints in a great measure lose their preservative properties. Inventor adds certain water-repellent materials previous to mixture with colours or pigments. For general use it is proposed to combine equal parts of euphorbia juice and a solution of gum resin,—*e.g.*, shell-lac.—H. A. R.

XIV.—AGRICULTURE, MANURES, Etc.

Proceedings of Convention of Agricultural Chemists, Philadelphia, 1884.

The Convention proceeded to formation of an "Association of Official Agricultural Chemists," for which analytical chemists connected with State Agricultural Departments, Experimental Stations, and Boards are alone eligible as members. The object is to secure legislative uniformity by the different States for the sale of, and uniformity and accuracy in the analysis of, commercial fertilisers. The Association adopted methods for—

1.—Determination of phosphoric acid in fertilisers, as, Total, water-soluble, and citrate-insoluble, phosphoric acid, the sum of the last two deducted from the total to give the citrate soluble, neutral ammonium citrate solution to be used of 1·09 density, the P_2O_5 to be precipitated by molybdic solution, and converted by magnesia mixture into ammonio magnesic phosphate, burnt, and weighed. Solutions of ammonium citrate, magnesium nitrate, magnesia mixture, ammonium nitrate, and molybdic acid to be prepared and used as directed.

2.—Potash in fertilisers is to be determined by aliquot part of 10grm. in 1000cc., representing 0·5 to 1·0grm., precipitated first by barium chloride, filtered, then barium hydroxide. Careful removal of all excess of baryta by ammonium carbonate, evaporation, re-solution, and soda and potash weighed as pure dry chlorides, the potash then precipitated by excess of platinum tetrachloride. The atomic weights adopted are :—

Platinum	197·18	Chlorine	35·46
Potassium	39·13	Oxygen	16·00

—J. R.

Improvements in Silos. J. B. A. M'Kinnel, Dumfries. Eng. Pat. 6008, April 5, 1884.

This specification is accompanied by drawings, and "the improvements consist in forming the ordinary built up or earth-embedded chamber with a hollow cover or casing, which serves to cover the fodder, and when filled with water or liquid, to apply pressure to the material within the chamber." The hollow cover is formed to correspond with the shape of the silo, and the upper end of the cover is fitted with a broad flange, which rests on the containing-walls of the silo, when the lower or piston-like part of the cover is fully down, it can then be cemented or fitted air-tight. The silo chamber is first filled with the grass or fodder, and the cover brought to bear on it. The hollow casing is filled with water until the weight compresses the material sufficiently. This process of filling and compressing is repeated as often as is necessary. To facilitate raising and lowering the cover it is suspended by chains passing over pulleys on carrying columns, fitted with counterbalancing weights or water-tanks.—W. M.

Improvements in Obtaining Certain Solutions containing Free Phosphoric Acid. E. Packard, Jun., Ipswich. Eng. Pat. 6176, December 19, 1884.

The liquid portion of the product obtained by acting upon phosphate of lime with dilute sulphuric acid (mixed or not with phosphoric acid) is separated from the solid residue, and this latter washed at least twice in wooden filterpresses. The first wash, mixed with strong sulphuric acid, is used for treating a further quantity of phosphate, while the second wash is utilised as the first wash for the next lot of solid residue. If more than two washings are given the same principle applies.
—A. R. D.

Improvements in Obtaining very Pure and Rich Superphosphates of Lime. E. Packard, jun., Ipswich. Eng. Pat. 6750, December 19, 1884.

Native or other phosphate of lime is treated with sulphuric acid in the presence of sufficient water to obtain a solution of monocalcic phosphate and free phosphoric acid. This solution is separated from the solid sulphate of lime, etc., and evaporated to a density of from 1·125 to 1·300. This causes almost the whole of the sulphate of lime and phosphates of iron and alumina originally existing in the solution to precipitate, while arsenic, if present, is removed by a current of sulphuretted hydrogen, or the addition of a suitable sulphide such as alkali waste. One filtration may serve to remove these impurities, and the filtrate may be evaporated to any required degree of dryness. —A. R. D.

Improvements in Obtaining from Native or other Phosphates of Lime, Products Rich in Phosphoric Acid and of a High Degree of Purity. E. Packard, jun., Ipswich. Eng. Pat. 6751, December 19, 1884.

Phosphate of lime is treated with sulphuric acid and water in such proportions as to yield the greater portion of the phosphoric acid in the free state. The solution is separated by filtration, and evaporated to a sp. gr. 1·125-1·300. Sufficient phosphate or carbonate of lime, or free lime, is then added to leave only about 30 per cent. of the phosphoric acid (not combined with iron and alumina) still in the free state. This causes the deposition of the sulphate of lime, and phosphates of iron and alumina contained in the phosphoric acid solution. The liquor filtered from these precipitated impurities is concentrated as required.—A. R. D.

Improvements in Obtaining from Native or other Phosphates of Lime Products Rich in Phosphoric Acid. E. Packard, jun., Ipswich. Eng. Pat. 6752, December 19, 1884.

To a solution obtained by treating phosphate of lime with sulphuric acid in such proportions that nearly the whole of the phosphoric acid (exclusive of that combined with iron or alumina) is obtained in the free state, lime, or carbonate of lime is added in such quantity as will combine with about two thirds of the free phosphoric acid. The resulting product is evaporated to the degree of dryness required.—A. R. D.

XV.—SUGARS, GUMS, STARCHES, ETC.

On Raffinose (Melitose?), a Kind of Sugar of High Rotating Power derived from Molasses. B. Tollens, Ber. Chem. Germ. 1885, pp. 26-28.

Some molasses which had been treated with strontium hydrate in the usual manner were allowed to stand for two years, when they appeared to be intersected by numerous needle-shaped crystals. Alcohol of 80 per cent. was added in such quantities that the mass could be filtered. After pressing and repeated crystallisation white needles were obtained, containing about 15 per cent. of water. An elementary analysis showed C = 42·46 % and H = 6·50 % for the substance dried at 100° C., which corresponds to the formula $C_{12}H_{22}O_{11}$ +

$3H_2O$ for the hydrated crystals. The polarisation of a 9·5986 % solution showed in the Landolt-Laurent apparatus a rotation $(a)_r = 102·5°-103°$. By heating this solution with a little sulphuric acid, the angle of rotation was reduced to less than half—viz., $(a)_r = 45°$. The matter is indifferent to Fehling's solution, but after heating with sulphuric acid it reduces an alkaline copper solution. Treated with dilute nitric acid it yields a substance similar to mucic acid and fusing at 210°-214°. These properties do not agree with any of the known compounds of the formula $C_{12}H_{22}O_{11}$, but they correspond well with a kind of sugar prepared from molasses by Loiseau and termed "raffinose." This substance offers all the more interest at present as the sugars which were produced in the last few years showed a higher polarisation than could be expected from their percentage of pure cane-sugar. Raffinose having a higher power of polarisation than cane-sugar, it appears probable that since the introduction of the strontium process the sugar of commerce contains a certain amount of raffinose, which would, of course, raise the rotating power of the sugar. Furthermore, it does not seem unlikely that raffinose exercises an influence on the crystallisation of sugar by causing the crystals to take a longish shape. Tenne and V. Schaaf have made the same observation with sugar prepared by the strontium process. The investigation of this interesting body not being finished, the author refrains from pronouncing an opinion whether his and Loiseau's substance are identical. —S. H.

Experiments in the Manufacture of Invert Sugar from Saccharose. F. W. Thompson, Burton-on-Trent. Eng. Pat. 8686, June 7, 1884.

ANY commercial saccharose is dissolved in water in suitable proportions, and the solution is heated to from 95° F. to 160° F., preferably 130°. Whilst the solution is at that temperature, yeast, ordinary pressed brewer's yeast by preference, is added in the proportion of 1 part of yeast to 100 parts of saccharose, and allowed to stand for five hours. At the end of that time the saccharose is completely inverted. It is claimed that by using the yeast at this temperature, or even by heating the yeast before use to 120° F., it still retains its inverting power, though it can no longer produce fermentation or convert the sugar into carbonic anhydride and alcohol as it would do under ordinary circumstances.—A. J. K.

Improvements in the Process of and Apparatus for Treating Megass for Extracting Sugar therefrom. G. W. Parbury, London. Communicated from Gustav Kottman, Sydney, N.S.W. Eng. Pat. 17,092, December 31, 1884.

BY this invention the sugar is extracted as completely as possible from the canes by the old process of squeezing through mills, and then the megass which is left is afterwards exhausted by the application to it of the diffusion process in a modified form invented by the authors. The apparatus designed for carrying out the process receives the megass either directly from the mills or after it has been more or less disintegrated by a special cutting or tearing machine. The diffusion apparatus (the construction of which cannot be exactly explained without reference to the diagram) is so arranged that the megass is made to rotate round a large cylinder in the opposite direction to a stream of hot water, until when the exhaustion is complete the megass passes out to another mill to receive a final squeeze, and the sweet water is separately drawn off and taken to the factory for treatment.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

On the Presence of Choline on Hops. Dr. Griess, F.R.S., and Dr. G. H. Harrow. Abstr. Proc. Chem. Soc. 1884-5 [5]. 35.

THE authors have separated choline—

$$C_2H_4(OH).N(CH_3)_3OH,$$

from hops by adding to a concentrated extract, acidified with hydrochloric acid, a solution of iodine in hydriodic acid. The semi-solid precipitate obtained—a choline periodide—was boiled with water to expel iodine, and the resulting solution of choline iodide treated with silver oxide; the impure choline in the solution was then converted into the auro-chloride, which was recrystallised. In this manner they have not been able to obtain more than $\frac{1}{50}$ per cent. of choline from hops. They consider it not improbable that it exists in loose combination with resin, as they find that a very dilute aqueous solution is capable of dissolving comparatively large quantities of hop resin, the liquid being then of intensely bitter taste. Employing the same method, they have also extracted choline from beer.—W. S.

Analysis of Two Californian Wines. J. L. de Fremery. Ber. 18, 426.

THE author has obtained the following results on analysis of a red wine "Zinfandel," and a white wine "Gutedel." 100cc. of wine gave in grms. :—

	Cabinet Gutedel.	Zinfandel.
Extract	2·0909	2·127
Alcohol	10·45	9·8
Mineral constituents	·1978	·2218
Volatile acids	·0804	·0972
Fixed acids	·4845	·4110
Tartar	·1579	·1428
Free tartaric acid	·0060	—
Other free acids	·5850	·5325
Sulphuric acid	·0381	·0168
Phosphoric acid	·0220	·0193
Chlorine	·0036	·0051
Lime	·0056	·0084
Magnesia	·0170	·0160
Iron	·0009	·0010
Alumina	·0003	·0001
Potash	·0973	·1055
Soda	·0019	·0035
Glycerine	·6133	·5647
Sugar	·0165	·0276
Succinic acid	·0068	·0097
Malic acid	·0324	·0922
Tannin	·0317	·1554
Colouring matter	·0085	·0520
Specific gravity (at 15° C.)	·9907	·9923
Polarisation	± ·2	± ·0
„ after inversion	± ·0	± ·0

—A. G. G.

Fuchsin in Wine. R. Kayser. Rep. Analyt. Chem. 4, 296-301.

100 CUB. CENTS. of the wine to be tested are shaken with 20 cub. cents. of colourless amylic alcohol, and then after diluting with water, the solution is examined with the spectroscope. If the characteristic absorption bands between the lines D and E of rosaniline compounds are observed, then the author recommends adding excess of ammonia solution to the sample of wine, and again shaking with amylic alcohol. If the alcohol solution is coloured red, then ordinary rosaniline has been the colouring matter employed; but if the alcoholic extract remains colourless, then the spectroscopic reaction is due to magenta S (rosaniline sulphonate). If these tests have given negative results, 100 cub. centimeters of the wine is warmed with excess of finely-powdered barium hydrate for two hours on the water-bath, and after cooling, the precipitate is filtered off and washed with water till the filtrate has a volume of 100 cub. cents. The filtrate is then evaporated to 10 cub. cents., acidulated with weak acetic acid, and examined spectroscopically for rosaniline salts and sulphonate. The precipitate may contain fuchsin, to obtain which lead acetate and ammonia are added, and the mixture well shaken with amylic alcohol, and the alcoholic extract again tested with the spectroscope. The sediment deposited by the wine may contain the rosaniline in combination with tannic acid, and can be examined in the way above described.—S. R.

Examination of Wine for Cane-Sugar. L. Medicus, Rep. Analyt. Chem. 4, 327-329.

THE author has examined pure white wines for cane-sugar before and after warming with hydrochloric acid, and finds that there is a greater quantity of reduced

copper after inversion. The method used was that of Soxhlet-Allihn. This increase he attributes to the inversion of a gum in the wine which he has succeeded in precipitating by the addition of alcohol, and by inverting the viscid precipitate obtained with hydrochloric acid and then reducing with copper solution has proved that the increased power of reduction of the wine after inverting is entirely due to this body. In estimating the sugar in wine the author finds it necessary to heat for the same length of time in all cases. With light-coloured wines it is not necessary to decolourise. With red wines animal charcoal must be used with caution: lead acetate, however, removes the colouring matter without carrying down the gummy substance along with the precipitate.—S. R.

Estimation of Glycerine in Wine. M. Barth. Pharm. Centralb. 25, 483-488.

THE amount of sand and lime added for the estimation of glycerine has an influence on the preciseness of the results. The author finds that with a quantity of wine which would yield 2grm. of extract, 1·3-1·5grm. of calcium hydrate should be added, and in ordinary wines 2grm. of sand, but with sweet wines it is best to have as much as 5grm. of sand to the same quantity of calcium hydrate. If these proportions of lime and sand are adhered to, no marked influence on the result is observed, whether the wine is evaporated almost or quite to dryness, if one takes care to dissolve all the residue off the dish. By observing these conditions one can obtain with 100 cub. cents. of the hot alcoholic filtrate 97 per cent., and with 150 cub. cents about 99-99 5 per cent. of all the glycerine.—S. R.

XVII.—PRESERVING FOOD, MEATS, Etc.

Improvements in the Manufacture of Meat Powder, and Methods for using the same. M. Bauer, Paris. Eng. Pat. 16,700, December 19, 1884.

THE object of this invention is to manufacture a new description of meat powder, without using a higher temperature than 167° F., from which all danger arising from bacteria has been removed, and which, although not subjected to boiling, is suitable for consumption as food. The meat, cut into thin slices, is placed in hot water for several minutes, then removed, and placed in a water bath, which is kept boiling for one or two hours. The meat is now minced, and the broth from the former process is evaporated and added gradually to the minced meat, which is heated to 160° F., until all the water is driven off.—W. M.

Improvements in the Manufacture of Preserved Meat and Vegetables, and Method of Packing the same. M. Bauer, Paris. Eng. Pat. 16,701, December 19, 1884.

THIS specification gives a detailed account of the manner in which certain proportions of meats and vegetables are to be prepared, steamed and stewed together, and finally hermetically sealed in tin cans.—W. M.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On Eucalyptol. E. Jahns. Ber. 17, 2941.

ACCORDING to Cloëz (*Compt. Rend.* 70, 687) the ethereal oil of the leaves of eucalyptus globulus consists, for the most part, of a substance, eucalyptol, which boils at 175°, and has the composition $C_{12}H_{20}O$. Faust and Homeyer (*Berl. Ber.* 7, 63), on the other hand, obtained a liquid boiling at 171-174°, which contained no oxygen, and appeared to be a mixture of cymol and a terpene. They considered their product, however, to be identical with that of Cloëz. The author points out that Cloëz obtained his oil by the distillation of the leaves of eucalypus globulus grown in Paris; while that of Faust and Homeyer was bought from a druggist in Leipzig: and he doubts whether they worked with the same substance. The author subjected some oil, obtained from Hr. Tromansdorff, in Erfurt, to fractional distillation, and found that the greater part came over between 170 and 180°, the residue consisting of terpenes and traces of phenols. It was not found possible to obtain a constant boiling product from this oil, nor from samples supplied by Merck, in Darmstadt, and Schimmel and Co., in Leipzig. Analyses were made of the different fractions between 171 and 178°; and it was found that the composition of the lowest boiling portion agreed with the formula $C_{10}H_{18}O$, while Cloëz's formula approximately represented the composition of the highest boiling fraction. That the product was a mixture was shown by the analyses, and by the different optical properties of the fractions. The substance was purified by the method of Wallach and Brass (*Ann. Chem. Pharm.* 225, 291). Hydrochloric acid gas was passed into the oil, cooled by a freezing mixture, and the crystalline mass quickly pressed and decomposed by water: the oil was again precipitated with hydrochloric acid. It was then warmed with alcoholic potash, washed with water, dried and distilled. It boiled constantly at 176-177°; its specific gravity was 0·923 at 16°; and it was optically inactive. Its odour resembled that of camphor. Its composition was found to be $C_{10}H_{18}O$. A study of its physical and chemical properties proved its identity with the substance to which the two names, cyneol and cajeputol, have been given. —S. Y.

On Juglone. A. Bernthsen and A. Semper. Ber. deut. Chem. Ges. 18, 203.

THIS is a lengthy paper on the preparation, properties, and probable constitution of juglone, a substance obtained by extracting nutshells with ether. Juglone seems to be a naphthalin derivative, and possibly an oxynaphthoquinone having the empirical formula $C_{10}H_6O_3$: it crystallises in shining red needles, is easily soluble in chloroform and glacial acetic acid, less soluble in alcohol and ether. It has acid properties, but the salts are not easy to obtain. An acetyl derivative was prepared. Oximides of juglone were obtained by reaction with hydroxylamine chloride; and juglonic acid obtained by the action of nitric acid appears to be a dinitro-oxyphthalic acid of the formula $C_8H_4N_2O_9$. —G. H. B.

On the Conine Group. A. W. Hofmann. Ber. 18, 5-23.

FOR a very long time the following formulas for conine and conhydrine were generally accepted:

Conine $C_8H_{15}N$. Conhydrine $C_8H_{17}NO$.

The latter base was therefore considered as the hydrate of the former, and this supposition seemed to be confirmed by Wertheim's experiments, who is stated to have converted conhydrine into conine by the abstraction of a hydroxyl molecule, by means of phosphorus pentoxide. On the other hand, the author recently proved that the formula of conine was undoubtedly $C_8H_{17}N$, and it was then thought that conhydrine may have the composition of $C_{18}H_{19}NO$, although some observations did not quite correspond with this presumption. On repeating Wertheim's experiments, the author found that the resulting basic oil was not of a uniform composition, but at any rate it contained no conine. The oil contains two or perhaps even three isomeric but different bases, represented by the formula $C_8H_{15}N$, which was formerly ascribed to conine. For these bases the terms of α and β-coniceïne are proposed.

1.—*Action of hydrochloric acid on conhydrine.*—Four parts of strong hydrochloric acid were treated with 1 part of conhydrine in a sealed tube at 220° C., for four hours. The resulting mass was supersaturated with an alkali, and the free bases appeared on the surface as an oily layer which after separating, was purified by distilling with steam. After removing the water and dehydrating with potassium hydrate, the oil commenced to boil at 150°, and the principal fraction distilled between 155° and 175° C. On saturating it with hydrochloric

acid two salts could be easily distinguished, which were separated from each other by converting them into picrates, one of which is only slightly soluble, whereas the other is easily soluble in alcohol. The free base of the first—α-coniceïne—is a colourless liquid boiling at 158°, and has the same smell and physiological properties as conine. It solidifies at 25° C., and its sp. gr. is 0·893 at 15° C. Then follows a description of some derivates.

2.—*Conversion of conine into α-coniceïne.* If 1 mol. conine hydrochlorate be mixed with 1 mol. bromine and an alkali be added, a bromine derivate of α coniceïne is formed, thus:

$$C_8H_{16}NH + BrBr + NaOH = C_8H_{16}NBr + NaBr + H_2O.$$

By treating it with sulphuric acid it is changed into hydrobromic acid and α-coniceïne, thus:

$$C_8H_{16}N\ Br - H\ Br + C_8H_{15}N.$$

3.—*Reconversion of α-coniceïne into conine.*—On digesting α-coniceïne with a great excess of hydroiodic acid (sp. gr. 1·96) and a small quantity of common phosphorus in a sealed tube at 200° C., α-coniceïne is partially reconverted into conine.

4.—*Reduction of Conine to Octane.* Conine was heated with hydroiodic acid in a sealed tube at 300 for 8-10 hours. The hydroiodic acid turns dark, and a colourless layer of octane appears at the top, whereas large quantities of ammonia are dissolved in the acid solution, and no conine is left. The reaction seems to proceed almost quantitatively, thus:

$$C_8H_{17}N + 2\ HI = C_8H_{18} + NH_3.$$

After separating and distilling over sodium it can be obtained in a pure state, boiling at 118° to 120°, and smelling exactly like petroleum. The author for the present reserves his opinion on the constitution of this hydrocarbon.

5.—*Bases formed by treating conhydrine with hydrochloric acid.* As mentioned above, the product of the reaction of treating conhydrine with hydrochloric acid contains a mixture of bases, from which α-coniceïne was separated as a picrate slightly soluble in alcohol. From the alcoholic mother liquor an oily product is obtained, which after purification yields a colourless liquid boiling between 165° and 170°. This liquid, however, is a mixture of α and β-coniceïne, and very likely of a third coniceïne. By converting it into the chlorhydrate and frequent recrystallising a salt was produced which is a derivate of β-coniceïne. From this salt the free base was prepared. It forms white crystals, melting at 41° C., and smelling like conine. Its physiological properties are far weaker than those of α-coniceïne.

6.—*Action of hydriodic acid on conhydrine.*—On treating one part conhydrine with four parts hydroiodic acid and some phosphorus in a sealed tube at 150 C. for three to four hours, a quantity of colourless prismatic crystals is produced, which are easily soluble in hot water. The analysis showed them to be hydroiodate of conine iodide, thus:

$$C_8H_{17}NO + 2HI = C_8H_{16}IN.HI \text{ and } H_2O.$$

This salt is therefore a source of preparing conveniently α-coniceïne. The iodine can be easily separated by boiling the salt with silver nitrate. On digesting it with silver chloride the hydrochlorate of conine iodide is obtained, which readily combines with platinum chloride to $2\,(C_8H_{16}IN.HCl)\,PtCl_4$. By boiling hydroiodate of conine iodide with silver chloride all iodine is replaced by chlorine forming hydrochlorate of conine chloride, $C_8H_{16}ClN.HCl$. Reduced with tin and hydrochloric acid the iodised compound is converted into free conine. Wertheim's idea of the relation of conine to conhydrine is thus proved to be a mistake. The latter cannot be converted into the former by means of dehydrating agents, but this conversion can be really effected by the use of hydroiodic acid.—S. H.

Researches on the Conine Group. A. W. Hofmann. Ber. 18, 109.

THE fundamental reaction of the research is the action of bromine on conine, and the products obtained are very various and depend on the relative quantities of the reagents employed. On account of the simpler character of the resulting reaction, bromine was caused to act on a salt of conine. A brominated compound is thereby formed of the formula $C_8H_{17}N.HBr.BrBr$. By the regulated action of sodium hydrate, the compound $C_8H_{16}NBr$ is obtained, and this gives rise to distinct isomeric bases by the different methods employed for the removal of HBr from this compound. These isomers are named α, β and γ-coniceïne, of the general formula $C_8H_{15}N$.; α-coniceïne is formed from the brominated compound by the action of sulphuric acid, and is a tertiary amine; β-coniceïne is a secondary amine and is described in a former paper along with the α-compound as products obtained from conhydrin; γ-CONICEÏNE is obtained by the action of an alkali on the brominated compound, and is also a secondary amine. It is noted that there are six possible isomers of $C_8H_{15}N$ according to present views. γ CONICEÏNE is a colourless liquid base, lighter than water, in which it is little soluble, but sufficiently so to impart a strongly alkaline reaction. It smells like conine and is very poisonous. It boils very constant at 173° and forms volatile crystalline salts with acids. The formation of a definite double salt with tin tetrachloride is very characteristic. It is worthy of remark that the different coniceïnes could not be converted from one isomeric form into the other. Further products were obtained in the reactions giving rise to the coniceïnes. Dimethylhydroxyconiine was obtained as a colourless liquid base of peculiar odour, little soluble in water but with an alkaline reaction, and a boiling point of 225°. It forms very soluble, not easily crystallisable salts, and has the probable formula $C_8H_{15}(CH_3)_2NO$. TRIBROMOHYDROXYCONINE is a bye-product obtained in the preparation of γ-coniceïne. It is obtained in crystals which decompose spontaneously in the free state, but forms more permanent crystalline salts and also double salts with platinum and gold chlorides. It seems probable that this compound was a derivative of conhydrin, but the latter could not be obtained from the brominated base. Dibromohydroxyconiceïne is obtained from the tribrominated base by the regulated action of sodium hydrate. It is an oily body, and also liable to spontaneous decomposition, but its hydrochloride is not crystallisable. HYDROXYCONICEÏNE is obtained from the dibromohydroxyconiceïne by the action of tin and hydrochloric acid. It is a colourless liquid which boils between 210 and 220°, and forms a crystalline hydrochloride. It corresponds to the formula $C_8H_{15}NO$. CONICEIDINE is the name given to a base containing no oxygen, and obtained from hydroxyconiceïne by long distillation with inverted condenser in presence of alcoholic potash, during which the elements of water are eliminated. It crystallises in colourless needles, which melt at 55-56° and boil above 300°. The analyses of the crystalline hydrochloride and platinum salt determine its formula as $C_{16}H_{26}N_2$, and its formation from hydroxyconiceïne corresponds to

$$2C_8H_{15}NO = C_{16}H_{26}N_2 + 2H_2O.$$

This body is dibasic and may be provisionally viewed as a homologue of nicotine.

Nicotine $C_{10}H_{14}N_2$ New Base $C_{16}H_{26}N_2$.

The latter part of the paper is devoted to a discussion of the possible constitution of the bodies of the conine group, which renders further experiments necessary before definite conclusions can be arrived at.—G. H. B.

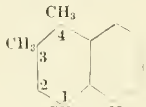
Synthesis of Homo-quinine. O. Hesse. Annalen, 226, 240-242.

PAUL and Cownley have shown that homoquinine, when heated with caustic soda and then ether added, is resolved into a mixture of 52 per cent. of quinine, which dissolves in the ether, and 45 per cent. of cupreine, which remains dissolved in the soda. The cupreine can be thus obtained by crystallising from ethereal solution in colourless prisms aggregated together, and melting at 191°. Cupreine forms compounds with both acids and bases. If cupreine and quinine in the above proportions be dissolved in excess of weak sulphuric acid, then ammonia

added and shaken with ether, homoquinine dissolves out, and can then be crystallised from the ethereal solution.—S. R.

Trimethylquinoline. L. Berend. Ber. 18, 376.

THE author has prepared this compound from pseudocumene (m. p. 63°) by Skraup's method. Trimethylquinoline melts at 42-43° C., and boils at 285-287° C. Owing to its extreme solubility in the ordinary solvents, it cannot be purified by recrystallisation. The analysis of the substance itself and also of the nitrate and the platinum salt, confirmed the formula $C_{12}H_{13}N$, and being derived from 1, 3, 4, 6 trimethylamidobenzene, its constitution may be expressed thus :—



—J. B. C.

On β-Naphthoquinolinesulphonic Acid I. C. Gentil. Ber. 18, 201.

β-NAPHTHYLAMINESULPHONIC acid in cohobated with glycerine, nitrobenzene and concentrated sulphuric acid, when a violent reaction sets in. β-naphthoquinolinesulphonic acid $C_{10}H_5(SO_3H):C_3NH_3+aq$? is formed and is prepared in a pure state after previous conversion into the barium salt. The acid crystallises in groups of white needles, and is difficultly soluble in cold but easily in hot water. By fusion with potash a β-oxynaphthoquinoline $C_{10}H_5(OH):C_3NH_3$ is obtained.—G. H. B.

Separation and Estimation of Methyl-Alcohol in presence of Ethyl-Alcohol. Dingler's Polyt. Journ. 254, [12], 500.

C. DE PONCY describes in the *Génic civil*, 1884, v. 5, p. 353, the following method :—Both alcohols combine readily with oxalic acid in presence of gaseous hydrochloric acid. The methyl-oxalate is readily soluble in water, the ethyl-oxalate only difficultly soluble ; the aqueous or alcoholic solution of both ethers, when treated with ammonia, gives amides quite insoluble in water. On these facts the estimation of the methyl-alcohol is based. 10·8grm. oxalic acid are dissolved in 10cc. of the alcohol to be examined, and hydrochloric acid gas is passed in to saturation. After standing for 24 hours in a closed flask, 2cc. of this solution are diluted and shaken with 10cc. water, and then filtered. As the methyl-oxalate is completely soluble in water, more oxamide will be obtained on the addition of ammonia, than would be the case if pure ethyl-oxalate only were present. A series of experiments establishes that the mean quantity of oxamide obtained from the wash-water is 6·6 per cent. for absolute ethyl-alcohol. For methyl-oxalate the number lies between 14·65 and 15 per cent. of the quantity of methyl-alcohol. If a mixture of ethyl- and methyl-alcohol be treated as above described, and the precipitated amides weighed, the percentage of methyl-alcohol present can be calculated. For every one per cent. methyl-alcohol from 0·14 to 0·15 per cent. more than 6·6 per cent. of oxamide is obtained.—G. H. B.

Process for the Estimation of Ethereal Oils. Dingler's Polyt. Journ. 255 [5], 216.

A. LEVANLOIS (*Comptes Rendus*, vol. 99, p. 977, 1884) estimates the ethereal oils in vegetable matters by distilling the latter with water in a short-necked distillation apparatus, and then adding bromine water until after energetic shaking a faint yellow colour remains. He finds that all the ethereal oils come over in the first portion of the distillate.—W. M.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

New Laboratory Apparatus. H. Landolt. Ber. 18, 56.

(1.) A COMBINATION of water-bath and hot-water funnel. It consists of a box of copper (Fig. 1) whose bottom is 38cm. long and 25cm. wide, with a back 11cm. high and a front 9cm. high. The top is made of brass. The higher portion serves as a water-bath for beakers, wash-bottle, etc., which stand on a perforated plate 1cm. above

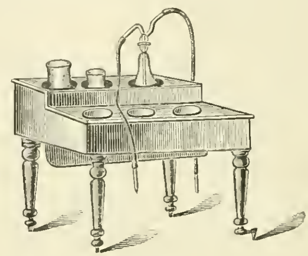


FIG. 1.

the bottom. The front part has three openings for funnels. The apparatus stands on four legs, 20cm. high, one of which is provided with a set screw. At the bottom is a vertical screen to keep the gas flame from the funnels. The filtration and drying proceeds very quickly in using these hot funnels. (2.) Arrangement for concentrating very dilute solutions. A sloping box of copper (Fig. 2) is supported on three legs and provided with a corrugated and rimmed top, made either of silver-plated copper or thin platinum. At alternate ends of the gutters passages are provided in order to compel the liquid to proceed in a zig-zag way. By means of set screws the inclination of the apparatus can be altered.

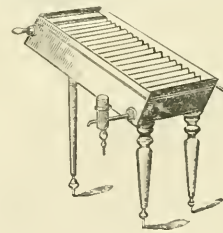


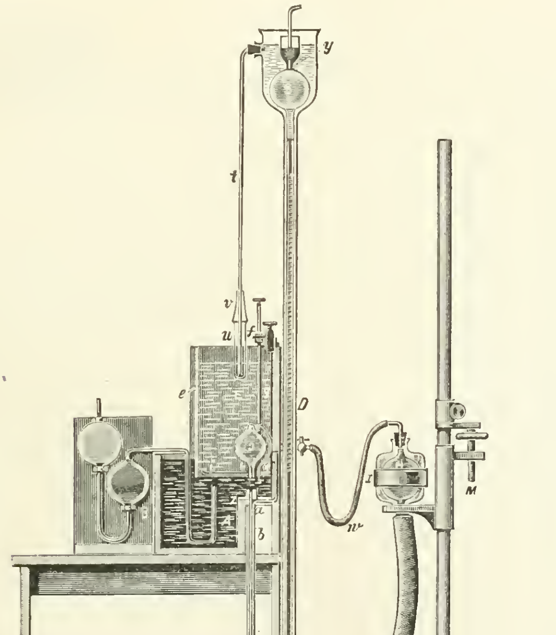
FIG. 2.

The box is filled with water through a gauge tube at the lower end, where it is also heated, whereas the steam escapes at the top end. The vessel containing the solution to be concentrated is placed in a high position, and by means of a syphon and a screw clip the feed is so regulated as to cause only a concentration and not the complete evaporation of the liquid. A part of the latter must therefore continually run off at the small overflow tube, which forms the continuation of the lowest gutter. A box, 38cm. long, 20cm. wide, and 10cm. high, with a total surface area of 850 square cm. evaporated more than one litre of water per hour. (3.) Apparatus for subliming. It consists of a thin platinum pipe 150mm. long by 18mm. wide, closed at one end and provided at the top with a stopper through which two glass tubes are inserted. Through one tube, reaching nearly to the bottom, cold water is allowed to flow into the pipe, which escapes through the second. The apparatus is inserted into the flask, which contains the mass to be

sublimed, and after withdrawing it the sublimate can be easily scraped off. If the sublimation has to be performed in a crucible, the projecting portion of the pipe must be protected from the combustion gases by a covering of asbestos to prevent the condensation of water on the surface. It has proved impracticable to make the contrivance of glass, as it soon breaks owing to the great difference of temperature. Besides many sublimates—*e.g.*, iodine—adhere very obstinately to the glass.—S. H.

The Estimation of Oxygen in Atmospheric Air. W. Hempel. Ber. 18, 267.

AFTER an exhaustive notice of the causes which may influence the proportion of oxygen in the atmosphere, and a plea in favour of a periodical and accurate estimation of oxygen in air in different parts of the world, the author describes an apparatus for the determination of oxygen by absorption with liquid reagents capable of yielding very accurate results. The gases are measured over mercury and corrections for temperature, barometric pressure and aqueous tension are eliminated (as in other well-known apparatus) and the absorptions are made in special gas pipettes. The apparatus is a modified form of that described by the author in his book on "Neue Methoden zur Analyse der Gase." The figure shows a sectional sketch of the apparatus. It consists of an iron trough A, which is in communication with the graduated barometer tube D by the iron tube b and is made fast to the table G. The barometer tube is in connection at m through the rubber tube J with the levelling ball H. The upper part of the iron trough consists of a water vessel E, which can be connected with a cask to receive the overflow of water. The water vessel E is provided with glass sides



reaching sufficiently low into the quicksilver to facilitate the introduction of the capillary tube of the pipette into the measuring ball C. The tubes b and D are enclosed in wider glass tubes, the rubber tube J of the movable level is double so that the tubes b, D and J can be kept cool by water, which flows into the apparatus during

work at o, p and q. A part of the water enters at o, then flows along the tube b and enters through a small canal at r into the water vessel E. A second stream enters at p, passes along the barometer tube D and s into the water vessel through t. The small wide tube u hangs by threads on t and is useful in preventing the spitting occasioned by the air bubbles passing down t. A third stream enters at q into the double rubber tube g and goes towards E through the rubber tube w. In this way all parts of the apparatus are kept at the same constant temperature. The gas is measured in the glass ball C, at constant volume, determined by a mark on the neck, and is transferred for absorption of oxygen to the gas pipette B which contains pyrogallate of potash. —G. H. B.

On a Lacmoid. M. C. Traub and C. Hock. Ber. 17, 2615.

THE authors prepare a colouring matter closely resembling litmus in the following manner:—100 parts of resorcinol, 5 parts sodium nitrite, and 5 parts of distilled water are slowly heated in an oil-bath to 110 C. A vigorous reaction sets in, and the contents of the flask become red; when the reaction has moderated the mixture is heated to 115-120°, till the evolution of ammonia has ceased and the melt has become blue. It is then dissolved in water and precipitated by HCl. The product is a glistening reddish-brown powder, which is insoluble in chloroform, benzol, and petroleum spirit, easily soluble in methyl-, ethyl-, and amyl-alcohols, less soluble in ether and water. In all its properties it closely resembles the colouring matter of litmus, with which it is possibly identical. It can be conveniently used as a substitute for the latter as an indicator. —A. G. G.

The Lacmoid as an Indicator. M. C. Traub. Arch. d. Pharm. [3], 23, 27-29.

THE lacmoid prepared from resorcinol is a very useful indicator, being more delicate than ordinary tincture of litmus, and capable of more general application than phenolphthalein, whilst it can be very readily prepared. The indicator solution is prepared by dissolving ½grm. of the lacmoid in a mixture of 50cc. of alcohol (96 per cent.) and 50cc. of water. Blue test paper is prepared from a solution containing 1grm. of the lacmoid dissolved in a mixture of 500cc. of alcohol and 500cc. of water and five drops of a solution of KOH.—A. G. G.

An Improvement in the Apparatus used for Precipitating Copper by Electrolysis. H. C. Foote. American Chem. Journ. vol. 6, No. 5.

THE author has devised a piece of apparatus for electrolytic determinations of copper, which possesses the advantage of maintaining a regular current of proper strength for several days, without a change of the battery fluids becoming necessary. The platinum dishes are arranged on a board, as shown in section by Fig. 2. The current from the battery is made to pass through a certain number of coils of fine insulated iron wire before it passes to the platinum dishes. Fig. 1 shows the under side of the board with the resistance coils and connecting wires sunk into it, so that no wires are visible above the board save the ones connected to the platinum strips dipping into the dishes. The current enters at a and passes to c, where it enters a switch, from which it may be made to pass directly to a switch at g; or it may be made first to traverse either one of the coils m, n, on its way, by a simple movement of the switch handle above the board. From g it may be made to pass through h to the switch at r; or by connecting the switch with i, k or l, the current will first traverse one, two or all of the coils o, p, q, and when it reaches r it will have the required strength. The coils have the following lengths of fine iron wire respectively: m, 1½ meters; n and o, 3 meters each; p and q, 4½ meters each. More coils may be added if it is desirable; but with the arrangement shown in the cut a resistance of 1½ meters may be obtained, which may be increased, by additions of 1½ meters each, up to 15 meters, by properly manipulating the switches c and g. For example: If the switch c be connected with e, and the switch g with i, the current will pass through 4½ meters of the iron wire. The board shown in the cut is arranged for only three dishes, but it will be readily seen that any number might be added. As the battery grows weaker, or as dishes are removed or added to the circuit, the strength of the current is kept uniform by manipulating the switches. This might be made to work automatically. The switch r, with its connections s, t and u, make it possible to use one, two or all of the dishes. If only one dish is to be used, the connection is made with s, and the current passes through the cylindrical copper connection v'' (see also Fig. 2, r) to the platinum, and finally through x'' to b. If two dishes are to be used, the switch r is connected with t, and the current passes first to the dish over v', thence through the platinum strip to x', and then to the second dish over v''. When all the dishes are to be used, connection must be made with u. The method of automatically regulating the current in the case of removing a dish from the circuit, is shown by Fig. 2—a coil of fine iron wire w, equal to the resistance of the solution in a dish placed under the board, and near each dish. Through the centre of the piece of platinum 3, 4, upon which the precipitating dish rests when in connection with the current, is a small hole, which is continued down through the board, and lined with a piece of copper pipe v, which is soldered to the platinum to make the connection. A short stick of wood 5, 6, passes through the pipe, and is so arranged with a spring 1, 2, that when the resistance coil w is in the circuit, the stick protrudes slightly above the platinum foil. When, however, a dish is placed upon the board it pushes down, by its weight, the stick 5, 6, removing the strip 1, 2, from contact with v, thus disconnecting the resistance coil, and at the same time causing the current to pass

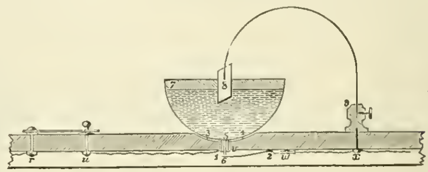


FIG. 2.

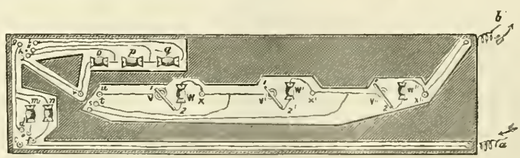


FIG. 1.

from *v*, through the solution and platinum strip to *r*. When a dish is removed, the current through 8, 9, is, of course, broken, and the spring 1, 2, comes in contact with *v*, making the connection with the resistance coil, which, being equal to the resistance in the dish, keeps the current the same in the other dishes. If two dishes are to be used, and the solution is only ready for one, the the switch *r* is connected with *t*, and the dish which is ready is placed on the platinum above *v''*. The current will then pass from *t* to *v'*, and through the strip 1, 2, to the resistance coil *w'*, and then through *x'* to *v''*, and finally through the liquid to *x''* and *b*. When ready to add the second dish to the circuit, it may be done by simply placing the dish in its place over *v'*, when it will automatically disconnect the resistance coil *w'*; and the strength of the current will remain the same, and sufficient for both dishes. Either one of the two dishes may now be removed at any time without altering the strength of the current, or in any way interfering with the work of the other dish in the circuit. The third dish may also be added at any time, by simply changing the switch *r* from *t* to *u*, and manipulating the switches *c* and *g*, so as to increase the current sufficiently. In the same manner, any number of dishes may be used. The strength of the current may be ascertained by passing it through acidulated water, in an inverted tube, graduated in cc., and noting the amount of mixed gases liberated in a minute.—J. B. C.

The Detection of Iodine in Presence of Large Quantities of Bromine. P. S. Brito. Chem. News, 50, 210.

If bromine and iodine be liberated by chlorine and the solution shaken up with chloroform, the violet colour of the iodine will be masked by the brown colour of the bromine when a large quantity of the latter is present. The violet at once appears on addition of ferric sulphate. —J. B. C.

New Books.

Neue Methoden zur Analyse der Gase. Von Dr. Walther Hempel, Professor am Königl. Polytechnikum zu Dresden. Mit in den Text eingedruckten Holzstichen. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn, 1880.

This work, important to all interested in technical gas analysis, is an 8vo volume, bound in paper cover and containing 129 pages of subject-matter, a table of contents, and twenty-two admirable woodcuts illustrating the apparatus in detail and in combined forms so as to indicate methods of working.

The Table of Contents will best illustrate the plan and method of the whole work. First Part—On Technical Gas Analysis. *I. General; II. Analysis by Absorption.*—Description of the Apparatus. the gas-burettes: A, the Simple Gas-burette; Mode of Handling the Gas-burette; The Modified Winkler's Gas-burette, B_1. the absorption-pipettes, B_2. The Simple Absorption-pipette for Solid and Liquid Reagents, C. the combined absorption-pipettes—The Combined Absorption-pipette, C_1. The Combined Absorption-pipette for Solid and Liquid Reagents, C_2. Handling the Absorption-pipettes. General Details concerning the Conducting of Absorption-analyses. Recorded Analyses. Special Details on the Estimation of the Simple Gases: 1, Carbonic Acid; 2, Carbonic Oxide; 3, Oxygen; 4, Heavy Hydrocarbons. *III. Analysis by Combustion.*—1. The Combustion by Explosion. General Description of the Apparatus. The Explosion-pipette. 2. The Absorption of Hydrogen with Palladium. 3. Fractional Combustion. Second Part—On an Expeditious and Exact Gasometric Method. *IV. General Description of Apparatus.*—The Measuring Bulb. The Adjustable Mercurial Niveau C. The Gas-pipettes. Handling the Apparatus. Measuring. The Absorptions. Recorded Analyses. *V. The Mercurial Trough without Barometric Tube.*

Acetic Acid and Vinegar, Ammonia and Alum. (Churchill's Technological Handbooks.) London: J. & A. Churchill, 11 New Burlington Street, 1885.

Small 8vo volume bound in cloth. As the preface shows, the work is edited by Mr. John Gardner, F.I.C., F.C.S. It contains 193 pages of subject-matter, short table of contents, and an alphabetical index, and is illustrated with twenty-eight woodcuts.

The first chapter of the book is devoted to Acetic Acid and Vinegar, and this includes a description of the process of carbonising wood in close retorts and obtaining pyroligneous acid. The second chapter deals with Ammonia, and the third with Alum and Alum-making.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, and MACHINERY.

3597 L. H. Pearce, London. Improved means for heating liquids, applicable also for vapourising and distilling the same. March 20

3731 E. B. Petrie and A. S. Fox, Manchester. An improved composition to be applied to straps, belts, ropes, and brakes used in and in conjunction with machinery, which composition is also applicable to other articles for the purpose of protecting and preserving them from injury arising from moisture or exposure to the atmosphere. March 23

3736 W. R. Lake. Improvements in and relating to steam-boiler and other furnaces. Communicated by L. Broussas, France. March 23

3896 J. H. Johnson, London. Improvements in furnaces for burning pulverulent materials. Communicated by M. Perret, France. March 26

3924 L. W. Sutcliffe, London. Improvements in self-feeding and smoke-consuming furnaces and appliances for heating muffles and drying stoves and for other like purposes. March 27

4048 F. W. Gordon, London. Improvements in hot blast stoves. Complete specification. March 31

4270 G. H. Lilley, London. Improvements in mills for reducing solid crystalline substances to powder. April 7

4377 T. W. Barber, Ulverston, Lancashire. Improvements in hot blast apparatus. April 9

4580 J. McInnes, Glasgow. An improved tube for transmitting air or other fluids under pressure. April 14

4613 R. McQueen Weir, Boone, Iowa, United States. Furnaces. April 14

4619 A. M. Clark, London. Improvements in stone and ore crushers. Communicated by D. Brennan, jun., and G. G. Young, United States. Complete specification. April 14

4666 J. S. Booth, London. Improvements in the construction of boiler and other furnaces. Complete specification. April 15

4710 M. Keenan, London. An improved non-conducting composition for protecting boilers, cylinders, pipes, and other objects against radiation. April 16

4711 M. Keenan, London. Improvements in means for protecting boilers, cylinders, pipes, and other objects against radiation. April 16

4834 C. Jones, London. Improvements in apparatus used when heating vessels or chambers by steam-heated jackets. April 18

4835 P. Jensen, London. A system or combination of pumps for producing vacuum. Communicated by L. A. Riedinger, Germany. April 18

4889 F. Maxwell-Lyte, London. Improvement in crucibles, muffles, and other refractory apparatus. April 20

II.—FUEL, GAS, and LIGHT.

3683 S. Clarke, London. Improvements in the manufacture of night-lights. March 21

3776 A. H. Reed, London. An improvement in the manufacture of hydrogen gas. Communicated by G. E. Moore, United States. Complete specification. March 21

3790 W. Black, Glasgow. Improvements in the manufacture of briquettes or fuel blocks. March 24

3870 R. Dempster, jun., Manchester. Improvements in the construction of condensers used in the manufacture or purification of gas. March 26

3908 A. T. D. Berrington, Ebbw Vale, Monmouthshire. An improved method of regenerating waste gases. March 27

4082 G. Brownen, London. Improvements in the manufacture of candles and night-lights, and in the preparation of oil or spirit, to cause disinfecting or deodorizing vapours to be given off from them when burnt. March 31

4119 G. L. O. Davidson, Manchester. Improvements in the construction of apparatus for washing or purifying smoke. April 2

4411 W. Black, Glasgow. An improved process of treating coal dross and other carbonaceous substances. April 9

4464 A. Klonne, London. The improvement in gas-washers called column-washers. April 10

4553 J. Roots, London. An improved method of treating illuminating oils to increase brilliancy of flame. April 13

4616 A. M. Clark, London. Improvements in, and in furnaces for, manufacturing illuminating gas. Communicated by F. Egner, United States. April 11

4798 S. Butler, London. Improvements in the manufacture of artificial fuel, and in machinery employed therein. April 18

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

4041 J. A. B. Bennett, Birmingham. Improvements in the method of introducing steam and other vapours and gases into carbonaceous matter during the process of distillation. March 31

IV.—COLOURING MATTERS and DYES.

3803 H. J. Haddan, London. Colouring matters obtainable by the combination of tetrazoditolyl or tetrazodixylyl-salts with alpha- and beta-naphthylamine or their mono- and disulpho-acids, and process for the manufacture of the same. Communicated by F. Bayer & Co., Germany. March 24

3889 J. Imray, London. Manufacture of blue and violet colouring matters by oxidation of the thio-bases of diamines. Communicated by J. Boasbonsson, France. March 26

4556 J. H. Johnson, London. The preparation of alkalised oxy-derivatives of a base resembling a chinoline base. Communicated by Dr. A. Scheidel, Italy. April 13

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

3632 P. Frankenstein, Manchester. Improved finish in colours on waterproof fabrics. March 21

3698 C. Moon, London. Making textile fabrics fireproof, and at the same time waterproof, yet allowing free ventilation. March 23

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

3718 W. Mather, London. Process for bleaching cotton yarns and fabrics. Complete specification. March 23

4118 J. Farmer, Manchester. Improvements in the construction of apparatus employed for washing, chloring, scouring, soaping, dunging, and dyeing woven fabrics. Partly communicated by A. Lalance, Germany. April 2

4281 J. Barnes, Manchester. Improvements in dyeing cotton and other vegetable fibres, and yarns and fabrics composed thereof. April 7

VII.—ACIDS, ALKALIS, and SALTS.

3761 W. P. Thompson, Liverpool. Improvemenns in the extraction of phosphorus from phosphide of iron or ferro-phosphor. Communicated by L. Imperatori, Germany. March 24

3816 B. Biggs and T. Terrell, London. Improvements in decomposing sulphate of iron, and in the obtaining sulphuric acid, sulphurous acid, and red oxide of iron thereby. March 25

3865 J. Anderson, Dundee. Improvements in the manufacture of sodium. March 26

3895 J. J. Hood, London. Improvements in the manufacture of chromates and bichromates. Complete specification. March 26

3933 F. S. Newall, London. Improvements in the treatment of alkali waste by other materials in order to obtain useful products. March 27

3934 F. S. Newall, London. Improvements in obtaining sulphur from sulphuretted hydrogen. March 27

4092 E. F. Trachsel, London. An improved method or process of producing carbonate of sodium. March 31

4101 D. H. Lowry, Liverpool. An improved caustic drum lid or appliance for closing small hand holes. April 1

4138 F. Maxwell-Lyte, London. Improvements in the manufacture of sodium aluminate and other aluminous compounds, and in the utilisation of gases resulting therefrom, and in the construction of furnaces used in the manufacture of sodium aluminate. April 1

4163 H. W. Todd, Liverpool. Improvements in or appertaining to caustic or other drum lids or closers. April 2

4175 F. J. B. Raken, London. An improved method of manufacturing carbonic acid (CO_2) under any desired pressure. Communicated by Dr. H. Beins and J. F. Beins, Holland. Complete specification. April 2

4261 A. McDonald Graham, Lewisham, Kent. Improvements in the manufacture of the sulphates of manganese and alumina. April 7

4274 H. Gaskell, jun., London. Improvements in the treatment of bicarbonate of soda for obtaining useful products therefrom. April 7

4285 G. Attwood, London. An improved method and means for the continuous oxidising and desulphurising of ores or minerals. April 7

4290 W. J. Chrystal, Glasgow. Improvements in the manufacture of chromates and bi-chromates. April 7

4436 C. Wigg, Liverpool. Improvements in apparatus for the manufacture of carbonate of soda. April 10

VIII.—GLASS, POTTERY, and EARTHENWARE.

3886 R. Boote, London. Improvements in the manufacture of pottery ware. March 26

3897 J. H. Johnson, London. Improvements in the manufacture of artificial stone. Communicated by I. Braadstätter, Austria. March 26

4181 G. F. Redfern, London. Improvements in or applicable to flatting furnaces employed in the manufacture of cylinder glass. Communicated by E. Masquelier, Belgium. April 2

IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

3916 E. Ormerod and W. C. Horne, London. Improvements in rendering cements luminous and damp proof. March 27

3932 J. Homan, London. Improvements in fireproof floors. March 27

4151 W. E. Heys, Manchester. Improvements in the manufacture of fire and waterproof boards or paper from asbestos. Communicated by E. Ladewig, Germany. Complete specification. April 2

4398 C. H. Murray, London. Improvements in means or apparatus for making bricks or other forms of clay or plastic materials. April 9

4441 W. Tapp, Bristol. A new or improved construction of tiles for stairs. April 10

4486 E. Ormerod, London. Improvements in apparatus and mode for the production of paving slabs, blocks, sinks, manholes, roofing tiles, and other similar articles in concrete, in terra-cotta and other similar materials. April 11

X.—METALLURGY, MINING, Etc.

3591 J. Smith, Stoke-upon-Trent. The manufacture of a new material for polishing or brightening metals. March 20

3623 P. M. Parsons, London. Improvements in the manufacture of ordnance. March 20

3724 W. H. Tooth and J. E. Rooker, London. Improvements in furnaces and apparatus employed in the manufacture and refining of iron and the conversion of iron into steel. March 23

3737 E. Morewood, London. Improvements in the manufacture of iron or other metal into sheets, plates, or other forms, and in stretching or extending or improving the surface of such sheets, plates, or other forms. March 23

3738 E. Morewood, London. Improvements in coating with tin, terne, or other coating metal, sheets, plates, or pieces of iron or other metal. March 23

3808 W. E. Wynne, London. A new and useful improvement in the manufacture of steel. Communicated by H. W. Oliver, jun., and J. P. Witherow, United States. Complete specification. March 24

3859 W. L. Wise, London. A method or process for the extraction of precious and other metals from millstone and other analogous stones or rocks. Communicated by V. Popp, France. March 25

3923 H. Wiggin (M.P.), H. A. Wiggin, A. S. Johnstone, and W. W. Wiggin, London. Improvements in the manufacture of nickel and cobalt. March 27

3989 R. A. Gilson, W. J. Booer, and G. Smith, London. Improvements in ovens applicable for heating iron castings preparatory to annealing them, and for other purposes. March 28

4016 M. Vesenmayer, London. Improvements in the method of collecting "float gold" in mining operations. March 30

4088 E. Matheson, London. Improvements in the manufacture of tinned or galvanised metal plates and like articles. Communicated by E. V. McCandless, United States. March 31

4228 T. Bayley, Birmingham. A method of manufacturing oxide of iron and obtaining other useful products. April 7

4309 G. F. Redfern, London. Improvements in treating auriferous and other metalliferous sand and dust and apparatus therefor. Communicated by A. Clement and G. Perret, Italy. April 7

4371 W. R. Lake, London. Improvements relating to the electro-plating of vegetable, animal, and other substances. Communicated by E. Quintallet and A. I. Mahu, France. April 8

4417 A. Lavroff and A. Scheasnovich, London. Improvement in anti-friction metal called Lavrow's phosphorous anti-friction metal. April 9

4474 C. D. Abel, London. Improved mode of and apparatus for utilising the waste gases of puddling and reheating furnaces. Communicated by F. C. Glaser, Germany. April 10

4478 W. E. A. Hartmann, Swansea. Improvements in treating waste liquors from the manufacture of tinplates. April 11

4498 W. A. Thoms and H. F. Oddy, London. An improvement in the coating of metals with an electro deposit of platinum. April 11

4563 F. W. Gerhard, Wolverhampton. Improvements in utilising blast furnace slag. April 11

4571 W. P. Thompson, Liverpool. Improvements in processes applicable for extracting phosphates from phosphatic slags. Communicated by G. Hoyermann, Germany. April 14

4605 F. Sharpe and M. H. Simpson, London. Improvements in machinery for breaking pig-iron. April 14

4706 W. E. Gedge, London. Improvements in the manufacture of metallic lead from the sulphurous ores thereof. Communicated by S. Trayner, Spain. April 16

4711 F. J. P. Cheesbrough, Liverpool. An improved process for the manufacture of iron and steel direct from the ore with gaseous fuel, and apparatus employed therein. Communicated by A. Hansen, Germany. April 17

4752 T. Cooper, London. Improved apparatus for the manufacture of chilled castings. April 17

XI.—FATS, OILS, AND SOAP MANUFACTURE.

3703 T. Rowley, H Grimshaw, and J. H. Kidd, Manchester. Improvements in the treatment of oils used in the manufacture of floorcloths, and for other purposes. March 23

3855 C. T. Kingzett, London. Improvements in the production of compounds or mixture to be used for the destruction of insects, also for washing animals, and generally as soaps or detergents, and for purifying purposes. March 25

3891 C. T. Kingzett, London. Improvements in the production of liquid soaps and other liquids which may be usefully employed as insecticides, also for washing animals, and for preserving and general purifying purposes. March 26

3977 L. A. Groth, London. A new or improved method of scouring or removing the oil from animal and vegetable substances by means of infusorial earth and heat. Communicated by A. Eberz, Germany. March 28

4090 G. Payne, London. An improved process of refining glycerine. March 31

XII.—PAINTS, VARNISHES, AND RESINS.

3839 E. V. Gardner, London. Improvements in the manufacture of white lead, and in apparatus to be employed therefor. March 25

4313 H. J. Allison, London. An improved substance for lining or covering steam boilers, pipes, and other objects. Communicated by S. Dohlmann & Co., Denmark. April 8

4415 P. Denniston, Glasgow. An improved anti-fouling and anti-corrosive composition for ships and submerged structures. April 9

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

4778 H. S. Barrow, J. Bestock, and G. A. Hardy, London. An improved finishing machine for leather. April 18

XIV.—AGRICULTURE, MANURES, Etc.

4718 T. H. Sclater, Kirkwall, Orkney. A new or improved combined insect destroyer and soil fertilizer. April 17

XV.—SUGAR, STARCH, GUM, Etc.

3781 W. Walker, London. Improvements in apparatus for extracting the water of condensation from sugar boiling apparatus. March 24

4332 A. Cook, Glasgow. Improvements in apparatus for reducing or disintegrating sugar canes or other vegetable substances. April 8

4758 B. H. Remmers, Glasgow. Improvements in the manufacture of starch and in apparatus employed therein. Communicated by L. von Wagner and A. Gillitzer, Austria. April 17

XVI.—BREWING, WINES, SPIRITS, Etc.

3706 J. H. Loder, Utrecht, Netherlands. Improvements in the manufacture of alcoholic beverages. March 23

3768 J. Clayton, London. Improvements in apparatus for lifting malt liquors. March 24

4068 W. Lawrence, London. Improvements in the manufacture of beer and malt liquors, and in apparatus for the treatment and preparation of materials for the same. March 31

4524 J. Death, jun., Cheshunt. Improvements in grain and its preparation for use in brewing and distilling, and for feeding purposes. April 13

XVII.—FOOD PRESERVING, MEATS, Etc.

4823 H. J. Haddan, Westminster. Process and compound for preserving eggs. Communicated by P. G. Wind and C. C. Lassen, Germany. April 18

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, Etc.

3682 J. R. Shopland, London. An improved method of and means or apparatus for purifying sewage and other liquids. March 21

4046 A. Engle, Liverpool. Destroying and utilising sewage in buildings, towns, and cities. Complete specification. March 31

4082 G. Brownen, London. Improvements in the manufacture of candles and night-lights, and in the preparation of oil or spirit, to cause disinfecting or deodorising vapours to be given off from them when burnt. March 31

4207 W. H. Beck, London. Improvements in processes for treating sewage and other waste waters for obtaining the fats, fatty acids, and fibrous matter contained in the same, and in apparatus to be employed therewith. Communicated by H. Wagener and Prof. Dr. A. Müller, Germany. Complete specification. April 2

4173 E. Langen, London. Method of and apparatus for treating semi-liquid substances with purifying or other liquids. April 10

4532 J. W. Slater, London. Improvements in the treatment of sewage and water polluted with organic matter. April 13

4677 T. Stoner and J. Turton, Bradford. A combined disinfecting and fumigating compound. April 16

4714 H. J. Haddan, London. A method of disinfecting. Communicated by G. Langhein, Saxony. April 16

4802 J. B. Austin, London. Improvements in the manufacture of disinfecting powder. April 18

XIX.—PAPER, PASTEBOARD, Etc.

3921 G. P. Barnes, Dulwich. Improvements in the manufacture of paper and in machinery therefor. March 27

3980 D. C. Simpson, Glasgow. A new or improved process of preparing paper or similar materials to render indelible writings or other markings thereon. March 28

3982 H. H. Lake, London. An improved method or process of sizing paper pulp. Communicated by L. Lacoste, France. March 28

4176 W. Manning, London. Improvements in the process of treating gypsum or sulphate of lime for use in the manufacture of paper, and for other purposes. April 2

4569 A. McDougall, Penrith. Improvements in the construction of boilers or other vessels used in the conversion of woody or other fibres into pulp for the manufacture of paper or other articles prepared from pulped fibres. April 14

XXI.—EXPLOSIVES, MATCHES, Etc.

3602 R. Punshon, London. Improvements in safety blasting cartridges and detonators. March 20

3918 W. F. Ruston, London. Improvements in detonating fog signals for railways. March 27

4547 C. D. Abel, London. An improved manufacture of nitrate of ammonia explosives. Communicated by F. Barbe, France. April 13

4853 J. Paulus, London. Improvements in caps or apparatus for exploding dynamite. Complete specification. April 20

*ENGLISH PATENTS PUBLISHED.**

APPLIED FOR DURING 1884.

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1885.

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*Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	....	½d.
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1912 W. Mather. Apparatus for steaming in the bleaching of fibres, fabrics, and yarns. 4d

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7260 E. Solvay. Manufacture of hydrochloric acid. 4d

7525 C. Wigg. Manufacture of carbonate of soda. 4d

8266 T. Higgin. Apparatus for disintegrating and removing impurities from lump salt. 6d

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1885.

1868 W. R. Lake. The protection of nitrate of ammonia against deliquescence. Communicated by R. S. Penniman. 2d

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2161 H. Faija. Means or apparatus for treating slurry or slip in the manufacture of Portland cement and bricks. 6d

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1885.

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1885.

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1885.

1531 C. Russell. Preserving meat. Communicated by A. Losasso, Calcutta. 2d

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8212 E. and A. Ashby. Process and apparatus for deodorising the fumes of cement and other kilns. 6d

14864 J. Y. Johnson. A new or improved disinfectant. Communicated by E. O. Beck, Paris. 4d

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11988 T. G. Young and J. Pettigrew. Treating vegetable substances in order to obtain pulp for making paper, etc. 4d

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7133 A. Schröeder. Apparatus for manufacture of nitroglycerine. 6d

12292 E. Luck and F. B. W. Roberts. Manufacture of explosives and treatment of materials employed therein. 4d

1885.

1174 J. H. Johnson. Marine torpedoes, etc. Communicated by — Howell. 10d

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THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 5.—Vol. IV. MAY 29, 1885. Non-Members 30/- per annum; Members 21/- per Set; Single Copies 2/6.

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Edmund K. Muspratt has been nominated to the office of President, and Dr. W. H. Perkin, F.R.S., has been nominated Vice-President under Rule 11.

Mr. I. Lowthian Bell, F.R.S., Dr. Peter Griess, F.R.S., Mr. John Spiller, and Mr. E. C. C. Stanford have been nominated Vice-Presidents under the provisions of Rule 8; and Sir Bernhard Samuelson, Bart., M.P., and Dr. S. A. Sadler have been nominated ordinary members of Council in the place of Dr. Peter Griess, F.R.S., and Mr. John Spiller, nominated Vice-Presidents under the provisions of Rule 17.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill the four vacancies thus created among the ordinary members of Council, in accordance with the provisions of Rule 18. Nomination forms for this purpose can be obtained from the General Secretary upon application.

Members are hereby informed that the Annual General Meeting (1885) will take place in London, on Tuesday, the 7th July, at 11 o'clock, in the Lecture Theatre of the City Guilds of London Central Institute, Exhibition Road, South Kensington, adjoining the International Inventions Exhibition.

The order of business will be:—Report of Council, Election of Office Bearers, and President's Address.

After an adjournment for luncheon, Mr. Frederick Siemens will read a paper—"On heating regenerative gas furnaces by radiation from flame, and on a producer to supply gas specially suitable for that purpose, and for the recovery of bye-products." Discussion on this important subject is invited.

In the evening the members will dine together at the Freemason's Tavern, Great Queen Street. Application for tickets should be made at an early date on the form inserted.

On Wednesday, 8th July, a visit will be paid to Messrs. Joynson & Co.'s Paper Mills, St. Mary's Cray (L.C. & D. Ry.). Messrs. Joynson & Co. will kindly provide luncheon. If possible, and prior to this, arrangements will be made to enable members to inspect Messrs. Orlando Jones & Co.'s Starch Factory, Battersea.

In the evening there will be a Conversazione and Reception by the President of the Chemical Society, Dr. Hugo Müller, F.R.S.; the President of the Institute of Chemistry, Dr. W. Odling, F.R.S.; and the President of the Society of Chemical Industry, Dr. W. H. Perkin, F.R.S., at the Galleries of the Royal Institute of Painters in Water Colours, Piccadilly.

On Thursday, 9th July, visits will be made to the Beckton Gas and Chemical Works of the Gas Light and Coke Company; to the Disinfectant Manufactory, at

Barking, and the Pumping Station at Crossness, belonging to the Metropolitan Board of Works; and to the Great Docks now being constructed at Tilbury, subject to the consent of the Directors. A commodious river steamer will be engaged for this excursion.

A time-table and detailed programme will be issued with the ballot papers and notices of the number of the Journal for June.

Friday has been left unoccupied to afford members an opportunity to visit the International Inventions Exhibition. Season Tickets, price 10s. 6d., can be obtained from the General Secretary of the Society. Members only are entitled to this privilege.

Members are hereby advised that the Subscription for 1885 falls due at the beginning of the year, and should be paid as soon afterwards as possible. The Council has decided that after January 1st, 1885, the 29th Bye-law will be strictly enforced, so that Members whose subscriptions are more than four months in arrear, will not continue to receive the Society's Journal.

Inquiries having been made as to the transactions of the Newcastle Chemical Society, the Committee of the Newcastle Section have to state that a very few complete sets are remaining, and will be sold to members at £2 10s. per set. A number of separate volumes can also be had by members wishing to complete their sets, at 10s. per volume (generally three years' issue). Application for these should be made to the Local Secretary of the Newcastle Section.

LIST OF MEMBERS ELECTED MAY 23rd, 1885.

J. M. Anthony, c/o E. G. Marks, 9, Nelson Street, Bristol, metal merchant.
Alex. J. Atkinson, 41, Loudoun Square, Cardiff, analyst.
T. J. Barr, 15, Garden Reach, Calcutta, and 13, London Street, Edinburgh, soap manufacturer.
Jas. Bell, 118, Southwark Street, S.E., asbestos manufacturer.
J. H. Bickett, Medical College, London Hospital, E., chemist.
L. Briant, The Laboratory, Crosswells Brewery, Oldbury, analyst.
William Bratby, Pott Street, Ancoats, Manchester, aerated water plant manufacturer.
T. Lynton Briggs, Star Chemical Works, Wandsworth Bridge Road, Fulham, S.W., chemical manufacturer.
J. H. Brinjes, Whitechapel Engine Works, Fieldgate Street, E., engineer.
A. M. Cheyne, c/o Messrs. Burgoyne, 16, Coleman Street, E.C., chemist.
W. Christie, 222, Brunswick Road, Bromley, E., sulphate ammonia manufacturer.
H. S. Collins, Messrs. Langton & Co., 230, Upper Thames Street, E.C., chemist.
Wm. Danson, 79, Burlington Street, Liverpool, analyst.
J. H. Darby, Pen-y-Garth, near Wrexham, ironmaster.
Geo. Dobson, Hanishen, near Cardiff, chemical manufacturer.
Henry Doulton, Lambeth Pottery, S.E., potter.
Reg. G. Durrant, Marlborough College, Wilts, schoolmaster.
T. Elborough, 59, Mark Lane, E.C., chemical manure manufacturer.
Jndoo Money Ghose, City College, 13, Mirzapore Street, Calcutta, chemist.
F. M. Haig, Carnforth Lodge, Hammersmith, W., distiller.
T. W. Hand, Public Library, Oldham, librarian.
W. H. Heaton, University College, Nottingham, professor of physics.
J. Wm. James, University College, Cardiff, demonstrator or chemistry.
H. A. B. Leipner, 8, Loftus Street, Sydney, New South Wales, analyst.
Jas. Longshaw, 7, Park Place, Cross Lane, Salford, manufacturing chemist.
T. D. Perkin, Greenford Green, Harrow.
W. H. Richardson, High Field, Southowram, Halifax, science student.
Hugh T. Spencer, Park House, St. Helen's, manager of plate-glass works.
Claude M. Thompson, University College, Cardiff, professor of chemistry.
E. E. H. Thorne, Denia Lodge, West Croydon, chemist.
H. W. T. Wager, 16, Charlotte Street, Portland Place, W., science student.
W. B. Waterfall, c/o Avon Manure Company, Bristol, chemical manure manufacturer.
J. H. Williamson, Golden Hill Works, Stoke-on-Trent, colour manufacturer.
Frank Wilson, The Brewery, Castle Street, Long Acre, W.C., brewer.

CHANGES OF ADDRESS.

W. T. Alexander, 20, Booth Street, Mosley Street, Manchester; and Crummock Bank, Victoria Crescent, Eccles.
Jno. Anderson (l/o Glasgow), Carnbroe Ironworks, Coatbridge, N.B.
R. Bindschedler (l/o Bolton), c/o Société pour l'Industrie Chimique, Basle, Switzerland.
H. E. Bunker (l/o Manor Park), 28, Wetherell Road, South Hackney, E.
F. Cheshire (l/o Somerset House), The Patent Office, Chancery Lane, W.C.
H. Sugden Evans (l/o Montreal), Department of Inland Revenue, Ottawa, Canada.
A. E. Fletcher (l/o Liverpool), 57, Gordon Square, London, W.C.
And. Haddow (l/o Abbey Street), 1 Keith Place, Easter Road, Edinburgh.
W. Hibbert (l/o Marylebone), 8, St. Dunstan's Road, Margravine Gardens, West Kensington, S.W.
S. Horrocks (l/o Manchester), 50, Prince's Street, Southport, Lancashire.
J. H. Irvine (l/o Strathbungo), North British Chemical Company, Clydebank, Glasgow.
W. H. Lake (l/o Jersey), Burton Dassett, Knight's Hill, Lower Norwood, S.E.
T. H. Leeming (l/o Lee Terrace), Burneston House, Barking Road, Plaistow, E.
Jas. Mackenzie, 21, Shuttle Street, Glasgow.
E. K. Mitting (l/o Leyton), Faversham, Kent.
J. H. Payne (l/o De Beavoir Road), New Hill Hall, West Melton, Rotherham.
Legh S. Powell (l/o St. James' Square), 5, Notting Hill Square, Campden Hill, W.
T. C. Sanderson (l/o New Cross), 21, Glengall Grove, Old Kent Road, S.E.
A. Seckendorf (l/o Ashley Place), 16, Mark Lane, E.C.
S. Sellon (l/o Kensington), Palace Club, Westminster.
V. Perronet Sells (l/o Redhill), The Grammar School, Bradford, Yorks.
Dr. A. Studer (l/o Manchester), Olten, Switzerland.
G. C. Thompson (l/o Garnet Hill), 39, Kersland Terrace, Hillhead, Glasgow.
Geo. Tunbridge (l/o Belgrave Road), 7, The Crescent, King Street, Leicester.
M. W. Williams (l/o Kensington), Queenwood College, near Stockbridge, Hants.
P. J. Winser (l/o Higher Broughton), Bank Quay, Warrington.

CHANGE OF ADDRESS REQUIRED.

J. A. Graham, l/o Sherborne Lodge, Werter Road, Putney.
F. T. Schreiber, l/o Hampden Street, Bolton.

London Section.

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S. Hall.	G. C. Trewby.
A. K. Huntington.	W. Weldon.
R. Messel.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

Meetings, Session 1885—First Monday in each month (unless otherwise indicated).

June 1.—Messrs. Salamon and W. de Vere Mathew—"The Influence of Phosphates upon Fermenting Worts." Mr. H. B. Yardley—"Additional Note on Alumina in Superphosphate." And other papers.
July.—The Annual General Meeting.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held May 4, 1885.

COMPOSITION AND MANURIAL VALUE OF FILTER-PRESSED SEWAGE SLUDGE.

(*Paper by* Prof. Munro, D.Sc., *read Jan.* 5, 1885.)

DISCUSSION.

The manurial value of filter-pressed sewage, as estimated by Professor Munro, was in no sense

disputed. The discussion by Messrs. Stanford, Coleman and Tyrer, was chiefly on the condition of the cake when turned out, and on the fact that the manurial value was so low as to preclude its use where much expense had to be added to alter its physical conditions of clogginess and moisture (the latter being put at 50 per cent.), or in transporting the product considerable distances. Messrs. Johnson and Hutchinson contended that it was at least as valuable as farm-yard manure under ordinary conditions, and that the mere mechanical question of comminution was practically accomplished by new modifications of disintegration machines which they were applying.

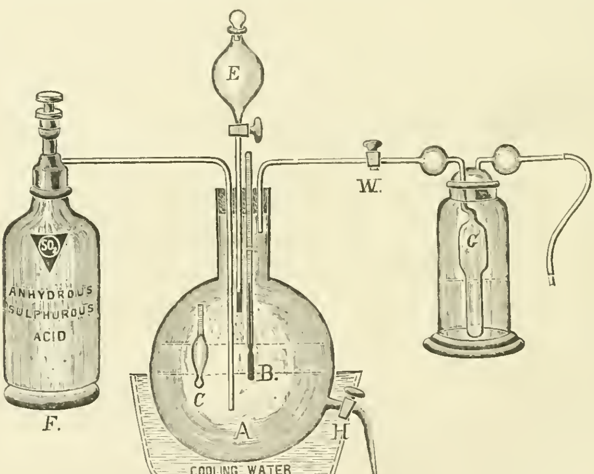
ON THE PERCENTAGE OF SULPHUROUS ACID IN AQUEOUS SOLUTIONS OF VARIOUS SPECIFIC GRAVITIES, AND ON ITS DETERMINATION THEREIN.

BY WM. B. GILES AND A. SHEARER.

In the course of last year, we had the honour of bringing before the notice of the Society some researches we had made with the view of arriving at a more accurate and speedy method of estimating the amount of sulphurous acid when in combination with bases, and the general result of our work may be briefly summed up as follows :—We found that it was necessary that the sulphite should be added to the iodine solution, and *not* the iodine to the sulphite, and that instead of diluting with water down to the percentage of ·05 per cent. of SO_2, as recommended by Bunsen, it was unadvisable to use any water at all, but simply to place the weighed solid or liquid body straight into an excess of decinormal iodine solution. The results we obtained in this manner were so satisfactory, and so concordant with those obtained by the much more tedious gravimetric process, that we resolved to make a further research as to whether the same method could be applied to the estimation of the acid itself in the free state. A considerable number of preliminary trials having shown us that the determination was as correct in the latter as in the former case, we finally resolved, as a crucial test, to use the pure condensed sulphur dioxide as a means of comparison. The gas (SO_2) employed, was deprived of moisture by passing it through a tube 10ft. long, filled with small flints continually kept wetted with concentrated sulphuric acid, and after being liquefied it was redistilled under pressure in glass vessels, and sealed up in small glass bulbs previously tared without any exposure to the air. In this form the sulphur dioxide appears to be almost chemically pure, the only impurity that could be found being a mere trace of hydrocarbon oil derived from the lubrication of the pump with which its condensation was effected. The glass bulbs, holding from three to four grammes, being weighed, were broken under a slight excess of pure decinormal iodine solution, contained in a stoppered bottle to avoid any possible loss of gas, the amount of excess being then determined as usual with thiosulphate. The mean percentage of SO_2 obtained was 99·68 per cent., and as this entirely confirmed our previous results, we resolved to construct a table showing the amount of this acid in its solutions of varying specific gravity, especially as from various cogent reasons we were led to doubt the accuracy of the only tables we have been able to find as having been made by previous observers. These tables, which are subjoined for the sake of comparison, are three in number—viz., those given by Anthon, Gautier and Wagner, and H. Schiff. As regards the first of these, it appears probable from Anthon's remarks that he prepared his acid by suspending calcic sulphite in water, adding the theoretical amount of sulphuric acid to it, and agitating till decomposition was perfect, after subsidence of the calcium sulphate the supernatant clear fluid was decanted ; if this is the case, it is not wonderful that his figures are wide of the truth. With regard to Gautier and Wagner's figures, we have not been able to find what method of estimation was adopted ; it may have been a gravimetric one, or Bunsen's mode may have been employed. They agree, however, better with our own results than the others, though there seems to be a constant error throughout them, leading to nearly all the figures for the amount of SO_2 being too low for the respective specific gravities. This might be expected if Bunsen's method was adopted, the free oxygen in the large amount of water, even when long boiled, tending to lower the actual percentage of SO_2. A glance at Schiff's figures will show that they are simply absurd. They appear to be derived from some erroneous theoretical calculations founded—or rather unfounded—upon data given by Bunsen. The results of a very large number of trials, conducted with every precaution that offered itself to our consideration, lead us to propound the following very simple law of the ratio between any given percentage of sulphur dioxide in an aqueous solution at 15·4° C., 760mm. and its specific gravity — viz., that under the foregoing conditions, the percentage of SO_2, multiplied by 5, gives the specific gravity of the solution over and above 1000. Thus, for instance, a solution containing 1 per cent. of SO_2 has a gravity of 1·005, one of 5 per cent. a gravity of 1·025, one of 10 per cent. a density of 1·050, and so on ; so that, on the other hand, if we know the specific gravity, we can of course at once tell the percentage of SO_2, provided that this is the only body present to influence the density. Whether this law be *absolutely* correct or not, is, of course, uncertain ; but it is undeniable that the experimental results exhibit an extraordinary agreement with the theoretical figures, and that for all *practical* purposes it may be assumed to be so.

The following details of the preparation of the varying specific gravities of the acid solutions, and the volumetric solutions employed, will serve to indicate the precautions that were observed by the authors :—1. The purest re-sublimed iodine obtainable was rubbed to a fine powder with excess of pure potassium iodide, and re-sublimed in the usual manner. It was then fused into a solid cake, and allowed to cool in a closely stoppered vessel. This fusion occasioned considerable loss, but it is the best way of obtaining the iodine in an absolutely dry condition, and the compact fused pieces are less subject to change during the operation of weighing than the micaceous scales which ordinary re-sublimed iodine usually occurs. The titre of the iodine was but slightly altered by this treatment ; in fact, the only impurity in the original iodine appeared to be traces of insoluble matter and moisture. Still, when this iodine was titrated in the usual way, it was always found that the weight indicated was slightly less than the actual amount. The cause of this was investigated, and found to consist in the fact that the purest obtainable potassium iodide contains a trace of caustic potass or potassium carbonate, or at any rate destroys a trace of iodine. When this was compensated for, the iodine was found to agree absolutely with sodium thiosulphate, which was twice recrystallised, specially granulated and air-dried till no adherence was observable in the particles of the salt. Two grams of potassium

bicarbonate were added to each litre of the thiosulphate solution, as recommended by Mohr, and the solution will, with this addition, keep for months with its titre absolutely unaltered if it be preserved in a cool place and in the dark. If kept in the light it speedily changes. A daily experience, extending over some years of work, enables us to speak confidently as to the unalterability of the iodine solution when pure materials are made use of. Verified burettes, with Erdmann's floats, reading easily to less than $\frac{1}{10}$ of a cc., were employed. The observers worked simultaneously, but with different balances, weights and burettes. Each observation was made at least six times, and the mean taken, in many instances—*i.e.*, in those about the specific gravity of 1040, as many as fourteen to fifteen different trials were made. The specific gravities were all obtained by direct weighings in 100-gramme flasks on Regnault's principle, no hydrometers being trusted to. (The small hydrometer seen inside the flask in the engraving, served merely as an approximate guide to the progress of the saturation.) Particular attention was given to the distilled water employed, as it had long been observed by the authors that an extremely small quantity of a base increases in a remarkable manner the apparent solubility, and hence the percentage of sulphurous acid. As an instance of this, it may be mentioned that if an excess of barium sulphite be suspended in water, the solution, under the influence of a stream of SO_2, rapidly attains a specific gravity of 1060, 15·4° C., yet this solution was found to contain only 0·16grm. of BaO in 100cc., which represents the maximum solubility of barium sulphite in sulphurous acid at 15·4° C. The water used was the middle portion of a distillate from a thirty-gallon copper still heated by steam, and it was boiled for three hours in the absorption vessel itself to get rid, as far as possible, of any dissolved oxygen before passing the stream of SO_2. The same water was used for diluting. The sulphurous dioxide was evolved from the pure liquefied acid contained in glass syphons with regulating screws. The water issuing hot from the still was introduced into the 5-litre flask A, nearly up to the neck. After boiling strongly for nearly three hours, it had decreased till it occupied a space about represented by the dotted lines in the figure, the steam passing away freely from the tap W, which was disconnected from the second flask G. At this period, without stopping the boiling, the sulphur dioxide was turned on from the syphon F, and not till this had saturated the boiling fluid was the lamp removed from under the flask A. The tap W was then connected to the second washer G, and the stream of gas maintained without the least intermission till the desired degree of saturation was attained at the normal temperature. This was reached in about twelve hours, when the lamp was replaced by a vessel of water supplied from the main, which enabled the temperature to be kept constant. This was noted by means of the thermometer B. The small delicate hydrometer C gave the approximate specific gravity. The stream of gas still continuing, the upper part of the vessel A was of course full of gaseous SO_2. To preserve the aqueous acid during the experiments, light purified petroleum oil was now allowed to flow in upon the surface of the acid through the stoppered-tap funnel E to a depth of about half-an-inch, after which the stream of SO_2 was discontinued, and the tap W also closed. By this method of procedure, all access of air from beginning to end of the operation was entirely prevented, and the contents of the vessel could be raised or lowered to any required temperature. A large flask of the same water was used for diluting the strong acid down to the lower gravities, boiled in exactly the same way, and allowed to cool, petroleum being floated on the surface to exclude air. By means of the stopcock H, with a drawn-out point, the acid was then run into the Regnault specific-gravity flasks and weighed, the flasks being tared before each weighing. After weighing, the flasks were then cooled in a freezing mixture, and the acid when sufficiently cooled was transferred to small, very accurately tared and stoppered bottles, which, after re-weighing, were first cooled to about 5° C., in the same freezing mixture, to avoid any loss of gas when the stopper was raised, as it was



invariably found that without this precaution the results were low from loss of gas, and then dropped into a slight excess of decinormal iodine, contained in a stoppered bottle, the excess of iodine remaining being estimated in the usual manner with thiosulphate.

The authors did not attempt to obtain any exact given percentage of sulphurous acid, or to arrive at round numbers in the determinations of the specific gravities, their attention being directed to obtaining correct results with the least possible exposure of the solutions to the air. Finally, they would remark that none of the figures in Table I. are interpolations, but all are results of absolute experiment.

TABLE I.—*Experimental Determination of Percentage of SO_2 in Solutions of various Specific Gravities.*

BY WM. B. GILES AND A. SHEARER.

Observed Specific Gravity.	Temperature.	Observed Percentage of SO_2
1·0051	15·5° C.	0·99
1·0102	,,	2·05
1·0148	,,	2·87
1·0204	,,	4·04
1·0252	,,	4·99
1 0297	,,	5·89
1·0353	,,	7·01
1·0399	,,	8·08
1·0438	,,	8·68
1·0492	,,	9·80
1·0541	,,	10·75
1·0597	12·5	11·65
*1·0668	11·0	13·09

TABLE II.—*Calculated Specific Gravities compared with Observed Specific Gravities. (The Calculated Specific Gravities obtained by multiplying the observed percentages of SO_2 by 5.)*

Observed Percentage of SO_2	Calculated Specific Gravity.	Observed Specific Gravity.
0·99	1·00495	1·0051
2·05	1·01025	1·0102
2·87	1·01435	1·0148
4·04	1·02020	1·0204
4·99	1·02495	1·0252
5·89	1·02945	1·0297
7·01	1·03505	1·0353
8·08	1·04040	1·0399
8·68	1·04340	1·0438
9·80	1·04900	1·0492
10·75	1·053750	1·0541
*11·65	1·058250	1·0597
*13·09	1·06545	1·0668

TABLE III.—*Calculated Percentage of SO_2 compared with Observed Percentage. (The Percentage calculated by dividing by 5 the units of observed gravity, above 1000.)*

Observed Gravity.	Calculated Percentage.	Observed Percentage.
1·0051	1·02	0·99
1·0102	2·04	2·05
1·0148	2·96	2·87
1·0204	4·08	4·04
1.0252	5·04	4·99
1·0297	5·94	5·89
1·0353	7·06	7·01
1·0399	7·98	8·08
1·0438	8·76	8·68
1·0492	9·84	9·80
1·0541	10·82	10·75
*1·0597	11·94	11·65
*1 0668	13·36	13·09

* It will be observed that these results are not *strictly* speaking comparable at all with the others, the temperatures at which such solutions exist preventing the observations from being made under the standard conditions; in such cases a deviation from the law must be inevitable.

TABLE IV.—*Tables given by previous Observers.*

ANTHON. SO_2	Density.	GAUTIER AND WAGNER. Density.	SO_2
0·95	1·005	1·0028	·5
1·90	1·009	1·0056	1·0
2·86	1·013	1·0113	2·0
3·82	1·016	1·0221	4·0
4·77	1·020	1·0275	5·0
5·72	1·023	1·0328	6·0
6·68	1·027	1·0397	7·0
7·63	1·031	1·0426	8·0
8·59	1·036	1·0474	9·0
9·54	1·046	1·0520	10·0

H. SCHIFF *(Ann. Ch. u. Pharm. 107, pp. 311, 312).*

Density.	Percentage of SO_2	Density.	Percentage of SO_2
1·0021	1	1·0343	12
1·0049	2	1·0376	13
1·0075	3	1·0410	14
1·0102	4	1·0445	15
1·0130	5	1·0480	16
1·0158	6	1·0517	17
1·0187	7	1·0553	18
1·0217	8	1·0591	19
1·0247	9	1·0629	20
1·0278	10	1·0667	21
1·0311	11		

DISCUSSION.

The CHAIRMAN congratulated the authors upon having furnished results which, from their reputation for accuracy and care, could be considered reliable; and the precautions taken to ensure this, especially in the more concentrated, and therefore more volatile solutions, commended themselves to his judgment. He also remarked that as a manufacturer of iodides the authors' observations were well founded, the presence of the traces of free alkali being not accidental, but essential, if stability of this salt was desired.

Mr. TYRER, endorsing these remarks, observed how fully the authors' numbers agreed with those of Mr. Umney, and confirmed by himself when examining the sulphurous acid of the then newly published edition of the *British Pharmacopœia.* These figures were given in the *Pharm. Journal,* March, 1869, as follows:—

Specific Gravity.	Percentage SO_2
1·005	1
1·011	2
1·017	3
1·022	4
1·027	5
1·032	6
1·037	7
1·042	8

Careful precautions were taken to secure uniformity of result, but he (Mr. Tyrer) must bear testimony to the superiority of those used by the authors.

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Manchester Section.

Meeting held April 28, 1885.

SIR H. E. ROSCOE IN THE CHAIR.

THE PRODUCTION AND FIXING OF COLOURING MATTERS BY MEANS OF ELECTRICITY.

BY J. J. HUMMEL.

Since the beginning of this century, when Nicholson and Carlisle discovered the decomposition of water by means of the electric current, electrolytic phenomena have engaged the attention of scientists to a greater or less degree.

In the hands of Davy, as you know, their study led to the analytical production of the alkali metals, and although some attention has been devoted to the electrolysis of organic compounds, that of inorganic substances has generally been the chief attraction.

In 1862, Dr. Letheby, of London, discovered in two cases of poisoning by nitrobenzene that this body was changed in the animal organism into aniline, and this could be distilled from the contents of the intestines and from the tissue of the body.

Letheby sought after the most delicate test for the presence of aniline, and found it in nascent oxygen, which caused mere traces of aniline to give a deep blue colour.

A single drop of a dilute aniline solution, say one gramme aniline in a litre of dilute sulphuric acid ($1H_2SO_4+7H_2O$), is placed upon a piece of platinum foil attached to the + electrode of a Bunsen cell. If the liquid is then touched with the − electrode, a deep blue coloured body is gradually deposited on the platinum. Half a milligramme of aniline can by this means be readily detected.

Thirteen years afterwards—viz., in 1875—Coquillon studied the electrolysis of aniline salts.

Coquillon, first of all, repeated Letheby's experiment, and confirmed his observations. After passing an electric current from two Bunsen elements through a concentrated solution of aniline sulphate for twenty-four hours, the + pole became coated with a greenish or bluish-black mass, which could be readily detached. When dry it formed an amorphous black substance possessing a metallic lustre.

Coquillon proved that the presence of a metal, or metallic salt, was not necessary to its production, for he employed carbon electrodes which had been perfectly cleansed by treating with chlorine, nitric acid, etc.

The account of Coquillon's results, in the form of a paper read before the Academy of Sciences in Paris, caused Goppelsroeder to publish in the same year, before the Société Industrielle de Mulhouse, a resumé of his independent work in the same field, with which he had been occupied since the autumn of 1874; and in 1876 appeared a detailed account of the same in his "Études Électrochimiques des Derivés du Benzol," a paper read before the same society.

A pupil of Schoenbein, Goppelsroeder seems to have early interested himself in ozone and its possible industrial applications—*e.g.*, in bleaching, ageing, etc. Eventually, he concentrated his attention on the study of the action of nascent electrolytic ozone on substances capable of yielding colouring matters by oxidation, and, in the first instance, upon a solution of aniline sulphate.

In his numerous researches on electrolytic aniline black, he noticed that the liquid in which the + pole was immersed varied in colour during the experiment, becoming yellow, orange red, and violet, at different periods, and only colourless when the aniline salt was fully decomposed. Filter-paper, cotton, wool, or silk, which was employed to conduct the current from one decomposing cell to the other, became also variously coloured, showing the presence of different colouring matters in the solution. Goppelsroeder showed, indeed, that electrolytic black is a mixture of aniline black with other colouring matters which could be extracted by successive treatment with various solvents, especially water and alcohol. The purified electrolytic aniline black formed a velvety black powder, which, according to analysis, seemed to be the hydrochloride of a base $C_{24}H_{20}N_4$. It may be noted, in passing, that this empirical formula does not agree with that of the aniline black base produced by other methods, which is given as $C_{18}H_{15}N_3$, but it is quite conceivable that there may be blacks of different composition.

From the beginning, Goppelsroeder has continued his researches with great zeal and earnestness, and has indeed made the field practically his own.

He has succeeded in obtaining most interesting results, and a resumé of these I now wish to place before you, illustrated by the series of specimens and elegant album of patterns dyed and printed by the electrolytic method, which Professor Goppelsroeder has kindly lent for the purpose. I am also greatly indebted to him for the liberal manner in which he has supplied me with his various original papers on the subject.

The several chapters of Goppelsroeder's work in which the employment of the electric current is the characteristic feature, are as follows:—

I. The production of colouring matters.
II. The simultaneous formation and fixing of colouring matters upon the different textile fibres.
III. The production of white and coloured discharge patterns upon dyed fabrics.
IV. The production of oxycellulose.
V. The preservation of printing colours liable to be destroyed by oxidation during the printing process.
VI. The reduction of colouring matters for the preparation of so-called vats (indigo, aniline black).

I.

The idea of producing various coal-tar colouring matters by means of electricity originated in the formation of the electrolytic aniline black already alluded to. The electric current was passed through solutions of various salts analogous to aniline hydrochloride, and in each case colouring matter, or a mixture of several colouring matters, was obtained.

It being necessary to prevent the effect of one pole from influencing that of the other, various forms of apparatus were employed, some of which are shown in the diagram.

The solution may be, for example, contained in a simple U-tube, loosely packed with glass wool in the bend, the poles of the battery being inserted in each limb; or the solution may be contained in two separate glass vessels, and the current conducted from one to the other by means of several sheets of filter-paper moistened with the solution; or the solution is placed in the inner and outer cell of an ordinary Bunsen element.

The electrodes employed may be of carbon or platinum; in some cases the negative electrode may be of lead.

The + electrode, which is the principal seat of the production of colouring matter, may be conveniently wrapped in calico. In this case the precipitate formed is deposited between the electrode and the calico, also in the pores of the latter, from which, after washing in water, the colouring matters formed can be removed by means of alcohol or other solvents. In making a qualitative examination of the colouring matters produced, advantage is taken of the fact that if a strip of blotting-paper is partly immersed in a solution containing several colouring matters, the latter rise by virtue of capillary attraction to different heights on the paper. Numerous filter-paper specimens, showing what information may be gained in this manner, are shown in the album exhibited.

The best yield of colouring matter is obtained when the solution surrounding the principal electrode is kept in constant motion.

In most cases the production of colouring matter, or other effect obtained, is to be ascribed mainly, if not entirely, to the decomposition of the solvent employed—viz., water. Oxygen gas is given off at the + pole, and hydrogen at the − pole. The oxygen, either in the nascent state, or as ozone, or by the production of hydrogen dioxide, acts upon the substance in solution, and converts it into colouring matter either by oxidising it or by removing a portion of its hydrogen.

The following is a brief resumé of Goppelsroeder's results relative to the production of colouring matter from various substances under the influence of the electric current:—

1. Aniline hydrochloride in acid and in neutral solution gives emeraldine and aniline black.

2. Aniline salt, with the addition of aniline and ammonia, gives only an insignificant deposit of a brown colouring matter soluble in alcohol, while the liquid acquires a deep red colour, and contains red and violet colouring matters, and these can be obtained by evaporating the solution to dryness and extracting the residue with ether and alcohol.

3. Salts of para-toluidine yield, as the main product, a brown colouring matter; also a little red and yellow colouring matter. Salts of ortho-toluidine yield, on the contrary, a violet colouring matter, similar to that produced by the action of bleaching powder; also small quantities of red, green, and brown and yellow; also emeraldine or aniline black.

4. A solution containing a mixture of 1mol. aniline hydrochloride, and 2mols. paratoluidine hydrochloride, gives a red-coloured solution at the + pole.

By employing a solution of commercial "aniline for red," imperfectly saturated with HCl or H_2SO_4, and with the addition of NH_3, a red and also a violet colouring matter is produced.

It is well known from the researches of Runge, Hofmann, and Perkin, that blue, red, and violet colouring matters are produced by oxidising aniline, or mixtures of aniline and toluidine, and it is not at all improbable that the colouring matters obtained by Goppelsroeder's method may be identical with those obtained by the older methods of oxidation, though I believe this has not yet been proved.

5. Solutions of aniline and toluidine salts, in the presence of potassium-nitrate, -nitrite, and -chlorate, yield at the + pole products from which rose-red and violet-red colouring matters can be extracted, which in their behaviour towards mineral acids remind one of the colouring matters of the safranine group.

6. Salts of methylaniline yield at the + pole a violet, and, under certain conditions, also a blue colouring matter. It will be interesting to know if the violet is identical with the well-known methyl-violet obtained by oxidising dimethylaniline according to Lauth's method.

7. Diphenylamine salts, with or without those of ditoluylamine and phenyltoluylamine, yield at the + pole a blue colouring matter soluble in alcohol. This may, of course, be identical with the diphenylamine blue produced according to the ordinary methods.

8. Salts of methyldiphenylamine give blue and violet colouring matters.

Salts of naphthylamine give a violet colouring matter, accompanied by small quantities of brown, yellow, and red colouring matters.

Turning now to the results obtained from the phenols:—

9. An aqueous acidified solution of phenol itself gives a brown colouring matter, and, under certain conditions, also traces of yellow and orange-red. An ammoniacal solution of phenol gives, under certain conditions, at first a blue, afterwards brown and pink colouring matters, with traces of violet and yellow. With certain additions—*e.g.*, NH_4Cl, KHO, K_2SO_4, KNO_3, the principal colouring matters formed are reddish orange, brownish yellow, and brown and yellow colouring matters, sometimes with traces of violet or red.

10. An acidified solution of naphthol gives as the principal product—a golden yellow colouring matter, possessing a green fluorescence, also a brown and a small quantity of red.

Goppelsroeder has also passed the electric current through solutions containing several substances, partly organic, partly inorganic, in order that by the interchange of certain atoms or atomic groups under the influence of the electric current, new compounds might be obtained.

A solution of magenta containing methyl-alcohol, H_2SO_4 and KI, gave at the positive pole Hofmann's violet.

Very interesting is the electrolytic production of alizarin from anthraquinone.

When the electric current is passed through a boiling solution of caustic potash containing finely-powdered anthraquinone in suspension, a deep red colouration is produced at the pole, due to hydro-anthraquinone, but it is rapidly decolourised under the influence of the air. Only when the caustic potash is extremely concentrated, and the temperature very high, is there a production of alizarin; in this case, during the passage of the current, the melted mass becomes first red (oxyanthraquinonate), then bluish-violet (alizarate), then reddish-violet (mixture of alizarate and purpurate), and then again red (purpurate). If the experiment is continued still longer, the mass becomes brown, then gradually lighter in colour, and finally white (potassium salts of organic acids and carbonate).

The alizarin is obtained by stopping the current whenever the deep bluish-violet colouration is attained, allowing the mass to cool, extracting it with water, and precipitating the alizarin from the solution by adding dilute acid. The yield of alizarin is always small.

At first sight it might be thought that at the high temperature employed, the transformation alluded to

would take place without the aid of the electric current, but experiment shows that this is only the case when the heating is continued for a very long time, and even then only traces of alizarin are produced. Further than this, it is noticed that if, when the red colour due to purpurate appears, the current is reversed, the mass becomes again violet, then red, and lastly greyish yellow, since alizarate, oxyanthraquinonate, anthraquinone, and even anthracene are probably reproduced.

II.

As to the simultaneous formation and fixing of colouring matters on textile fibres, the best examples are those of aniline black and canarin yellow.

The following is the arrangement which Goppelsroeder has found suitable for the purpose of printing or writing in aniline black by electrolysis on textile fabrics:—

A lead plate insulated by resting on a sheet of indiarubber serves as the negative electrode. On this rest a dozen folds of calico suitably moistened with dilute sulphuric acid (1 : 10) in order to conduct the electric current, and on these the piece of cloth (silk or cotton) on which the colour is to be produced. The latter is impregnated with a strongly-acidified solution of aniline hydrochloride (about 125grm. per litre).

A second metallic plate, preferably of platinum or gold, serves as the + electrode; this is gently pressed upon the prepared fabric, and the electric current is passed through for one or two minutes. On removing the + electrode, a fixed and permanent impression in aniline black is produced.

If the − electrode is in the form of a stencil plate or an engraved plate, a pattern corresponding to the design upon it is of course produced. Goppelsroeder has also made experiments in printing continuously by means of engraved cylinders.

So rapid, indeed, is the production of the black, that by making the + electrode in the form of a rod of carbon, gold, or platinum, it is possible to write indelibly upon the fabric in aniline black as rapidly as in the ordinary manner.

The characters or design thus produced, after washing with alkaline solution, are perfectly fast, since the fundamental law governing the fixing of colouring matters is properly fulfilled; the colouring principle or chromogen is presented to the fibre in a soluble condition, and is there rendered insoluble.

Goppelsroeder suggests that the electro-chemical method here described might be utilised in print-works, bleach-works, etc., for marking indelibly the piece-ends; also in the customs and telegraph departments.

Dyeing with aniline black may be accomplished by first depositing on the textile fibre a thin metallic layer. Thus rendered a good conductor of electricity, the fibre itself may serve as the + electrode, and be placed in the aniline salts solution; the dyeing would then at once take place on plunging the − electrode into the solution.

Canarin, or perthiocyanogen $C_3N_3S_3H$ is a deep yellow amorphous powder, produced ordinarily by the action of nitric acid or chlorine upon a boiling solution of potassium thiocyanate. It has recently been introduced as a dyestuff for cotton, since it resists the action of light and soap solutions extremely well, and also acts as a mordant for basic coal-tar colouring matters.

By treating the thiocyanates of aluminium and potassium as if for aniline black, and then steaming, "canarin" yellow is at once developed and fixed upon calico; and very probably the remembrance of this process of H. Schmidt caused Lidow and also Goppelsroeder to submit ammonium and platinum thiocyanate to electrolysis.

On passing the electric current through a cold solution of either of these salts, little or no action takes place; but if the solution be heated (preferably to the boiling point), an orange-yellow flocculent precipitate of persulphocyanogen is produced at the + pole, the thiocyanate being entirely decomposed.

Canarin yellow may also be simultaneously produced and fixed upon textile fibres by the method adopted for aniline black. A piece of calico, for example, is impregnated with an aqueous solution of potassium thiocyanate, then spread out upon a number of folds (8-16) of calico, similarly moistened, and resting upon a piece of platinum foil which serves as the − electrode. On placing another piece of platinum acting as the + electrode, upon the prepared calico, and passing the current, the cloth immediately beneath the + electrode is permanently dyed from a canary-yellow to a dark orange, according to the intensity and duration of the current.

III.

Although many colouring matters, as we have seen, are produced by oxidation, most of them are destroyed if submitted to excessive oxidation. This fact is made use of by the calico-printer in the production of so-called discharge patterns—*e.g.*, on Turkey-red and indigo blue grounds. Such discharges may also be readily produced by the electrolytic method.

A piece of Turkey-red or indigo-blue calico is impregnated with a solution of sodium or ammonium chloride or nitrate. Beneath are a number of folds of calico similarly moistened, resting on an insulated sheet of platinum serving as the − electrode. If the positive pole, in the form of a platinum sheet, etc., is pressed on the prepared cloth, there is at once a production of chlorine or HNO_3, according to the salt solution employed, which attacks the colouring matter, colourless oxidation products are formed, and a white discharge on a red or blue ground is the result.

With a view of accelerating the reaction, Goppelsroeder acidified the salt solutions with sulphuric acid. Without such acidifying there was always a production of caustic alkali at the − pole.* Albert Scheurer has recently shown that the bleaching action of chlorine gas is considerably more powerful in the presence of caustic alkali, and by substituting caustic soda for sulphuric in his experiments Goppelsroeder also finds the bleaching action to be stronger, and has obtained most excellent discharges, whether the salt used was sodium chloride or nitrate (*Journ. Soc. Chem. Ind.* 478, 1884).

In order to obtain a sharp impression it is necessary to protect the cloth, not covered by the + electrode, by means of glass plates. These prevent the spreading of the liberated gases.

If such salts are chosen whose bases are liberated by electrolysis, and can act as mordants, it may be possible, by dyeing the cloth subsequently, to produce *coloured* discharges. Such might, of course, be at once produced if the liberated oxides were themselves coloured, or became so through being oxidised still further by the electrolytic oxygen.

These ideas thrown out by Goppelsroeder have been partly submitted to the test of experiment, and he finds that by impregnating calico with the usual iron and aluminium mordants, and passing the current through them, as already described, they become mordanted in contact with the + electrode, and produce impressions darker than the surrounding tissue, when subsequently dyed up with alizarin.

He has further attempted, but with what success I know not, what might be called an electrolytic topical style of printing—namely, to produce simultaneously,

in presence of the fibre, mordanting oxides, and such colouring matters as would combine with these to form coloured lakes. Under the conditions imposed, this seems an extremely difficult problem.

Black discharge patterns, on red or blue grounds, are readily produced by fixing the electrolytic aniline black on Turkey-red or indigo blue. It would appear that there is not a mere superposition of the black, but a simultaneous destruction or discharging of the red or blue beneath.

Yellow discharge patterns, on blue and red grounds, are produced by means of the electrolysis of potassium thiocyanate; but they seem to be less successful.

A very good yellow pattern, on blue or red ground, however, is obtained by first producing a white discharge, according to the method already described, then impregnating the whole cloth with potassium thiocyanate, and going over the discharged places with the + electrode, when, of course, yellow canarin is produced.

IV.

It is impossible to imagine that in the discharging or production of colouring matter by such a powerful oxidiser as the electrolytic oxygen, the fibre itself should remain unaffected. A few experiments suffice to show that by lengthened action of the electric pen, holes in the fabric are produced, the fibre being destroyed just as it would be by the action of strong bleaching powder.

Before, however, this extreme condition has been attained, Goppelsroeder has proved that in the case of cotton the fibre becomes changed into oxycellulose, just as it is, according to the researches of Witz, under the action of hypochlorous acid.

The most characteristic property of oxycellulose is that it readily attracts and becomes dyed with the basic coal-tar colouring matters without the aid of a mordant, whereas cellulose requires to be prepared with tannic acid to give a similar result.

If a piece of cotton or linen cloth be impregnated with a neutral, acid, or alkaline solution of sodium -chloride, -chlorate, or -nitrate, and be placed upon 8-16 folds of similiarly moistened cloth resting upon a sheet of platinum as the − negative electrode, and if it be then impressed with a platinum plate, serving as the + electrode, after the current has passed through for some time, the products given off at the + pole will so change the fibre immediately in contact with it, that after washing, that portion will dye up in a solution of methylene blue or other basic coal-tar colouring matter, exactly as though it were mordanted with tannic acid. The effect is due to the oxycellulose produced.

On discharging Turkey-red and indigo-blue by the electrolytic method, the cellulose is similarly modified in the discharged portions, so that by dyeing afterwards in various basic coal-tar colouring matters, one may obtain coloured discharge patterns on an indigo-blue ground.

V.

Hitherto, except in the case of the electrolytic production of alizarin, I have referred to experiments in which the positive pole plays the principal part. Let me now refer to other instances in which the negative pole is the most important.

There are several printing colours which, by reason of too rapid oxidation, present difficulties to the calico-printer during the printing process—*e.g.*, the aniline-black printing mixture, reduced indigo, etc. Goppelsroeder proposes to prevent the premature oxidation of such during printing, by putting into the colour-box the − electrode of a small battery or dynamo, and connecting the contents of the colour-box by means of a porous diaphragm, tube, etc., with a smaller supplementary box, filled with the same printing colour, in which the − electrode is placed. The hydrogen given off at the − pole would prevent the oxidation of the colour.

Another service which he thinks might be rendered by the − pole would be that of precipitating, on the textile fibres, the heavy and noble metals, several of which are used in printing. The fabric would require to be impregnated with a thickened solution of the metallic salt, and the − electrode caused to act upon it in order to precipitate and fix the metal.

VI.

The hydrogen of the − pole can also be used for the conversion of the nitro compounds of the aromatic group of bodies into amido compounds. Nitrobenzene can be changed into aniline, for example, and a patent seems already to have been taken out for this purpose; also for the reduction of such colouring matters as aniline black and indigo, to form vats suitable for purposes of dyeing.

In the case of indigo, for example, this dyestuff is finely ground and mixed with a somewhat concentrated solution of caustic alkali. This mixture is placed in a porous earthenware cylinder, resting in a copper vessel, also half-filled with the same alkaline mixture. The copper vessel is connected with the − pole of a galvanic battery; while a strip of platinum attached to the + pole is inserted in the contents of the porous jar. It is well to heat the contents of the copper vessel to the boiling point to accelerate the reduction.

Although hydrogen gas is given off in large quantities at the − pole, in the cold the reduction is very incomplete; but when the alkaline mixture is heated, the evolution of hydrogen ceases, since it then reacts upon the indigo-blue and changes it into indigo-white, which dissolves in the caustic alkali. The characteristic odour of the ordinary indigo-vat is soon perceptible, the solution in the copper vessel acquires a greenish yellow colour, becomes covered with the usual indigo "flurry" or scum, and may serve for dyeing according to the ordinary method.

It is, however, not at all necessary to wait till the indigo is completely reduced, it suffices to allow the current to pass through the mixture for a short time, and then at once alternately to immerse the fibre in the liquid and to expose it to the air.

It is possible even to reduce the indigo upon the fibre itself, so that in the moment of reduction the fibre shall be at once impregnated with a solution of indigo-white, and it requires then only to be exposed to the air to become permanently dyed.

To this end the fabric to be dyed is impregnated with a solution of caustic alkali, mixed with finely-ground indigo, and placed between two metallic plates, one of which forms the +, the other the − electrode. After passing the current through for a short time, and exposing the fabric to the air, it is dyed blue.

With a current of suitable intensity, it might even be possible to dye calico pieces continuously, by passing them (previously impregnated with the mixture of alkali and indigo) through a pair of metal rollers, which formed the + and − electrodes of an electric battery. The cloth would, of course, require to be exposed afterwards to the air and washed.

It is worthy of note that if the passage of the current be too prolonged, the indigo is gradually destroyed, which is quite in harmony with the fact that the indigo is also destroyed in the woad-vat by excessive fermentation.

And now, gentlemen, the first question which is no doubt ready to escape from the lips of many of you is:

Is it possible to apply the electric current in practice in the manner described, and is there any advantage in so doing over the older methods of obtaining the results desired?

In answer, let me quote from a letter I have recently received from Professor Goppelsroeder. He says:—

"After having opened up this new field of research, as one fact after another comes to view, I become more and more convinced that the seed sown will gradually develop into a plant which will sooner or later bear fruit, and that this new use of electrolysis will some day belong not only to pure but also to applied science. The greater the number of workers in the field the more rapidly and abundantly will fruit be obtained.

"At present I give to science the simple facts just as I find them, without asking whether or not they will find a use to-morrow or only after many years. If in making scientific researches one were always to consider carefully what difficulties might stand in the way of practically applying results obtained, research would often be hindered, if not entirely paralysed.

"In this special electrolytic domain, the question is, whether the new process of producing and fixing colouring matters by electrolysis possesses any advantages over the old method as regards cost and simplicity. Of course the more dynamo machines are improved, and the price of the necessary current is lowered, the more likelihood there will be of the subject passing from the laboratory to the workshop, at first possibly only in a modest degree, but afterwards, perchance, quite universally.

"Should this end ever be attained, there seems to me to be the possibility of electricity being used for the following varied purposes:—

"1. The production of colouring matters and their intermediate products.

"2. The bleaching of textile fabrics.

"3. The dyeing and printing of textile fabrics.

"4. The discharging of dyed colours.

"5. Heating and illumination.

"6. Chemical telegraphy.

"The future alone will show whether electricity is capable of playing such a many-sided rôle."

DISCUSSION.

Mr. Levinstein: As Professor Hummel has already stated in his interesting paper, none of Goppelsroeder's efforts to produce colouring matters by electrolysis have passed the precincts of his laboratory. It may, therefore, be interesting to mention a patent which has been taken by Ewer and Pick in Berlin for the production of colouring matters containing sulphur (XXII. E. 1258), which, as far as I am aware, has not yet been printed. The method which these chemists propose, combined with the very ingenious apparatus for carrying it into effect on the large scale, appears to me not at all unlikely of being introduced into practice. Ewer and Pick insert two platinum plates or rollers, which form the two poles of an electric current, into a diluted sulphuric acid solution of paramidodimethyl-aniline, containing hydrogen sulphide. As soon as the evolution of hydrogen takes place, the liquor round the anode is coloured blue—this colouration, however, soon disappears, while the anode is covered with a grey precipitate. When this precipitate is removed, the liquor close to the anode again becomes blue, then disappears, and a precipitate is once more formed. This process of colouration of the liquor and formation of colouring matter continues, until at last all the hydrogen sulphide is used up, and the whole liquor becomes dyed an intense blue. The precipitate is the leuco base of the methylene blue. As I already stated, the process appears to me practical, not alone on account of the ingeniously contrived apparatus proposed by the inventors, which you will soon have an opportunity of seeing fully described in our Journal, but also on account of the present unsatisfactory mode of producing methylene blue, by which method useless bye-products are formed, and the yield of valuable blue colour is far short of what theoretically it ought to be. Ewer and Pick claim the avoidance of the production of bye-products, and, as I assume, a quantitative yield of colouring matter

NOTE ON TITANIC ACID AS A MORDANT.

BY. J. BARNES.

The property possessed by titanic acid of combining with colouring matters presented itself to my notice during the course of some experiments to discover if alizarin is a reliable reagent to distinguish alumina from other white precipitates which may be thrown down by ammonia—*e.g.*, hydrated silica, phosphates of the alkaline earth metals, etc. I found that precipitated titanic acid gave a reaction very similar to that produced by alumina. This induced me to prepare some cloth with titanic acid, with the view to ascertain whether it would act like alumina as a mordant for colouring matters. The cloth, which had been previously oiled as for Turkey red, was soaked in an aqueous solution of titanium chloride containing some sodium acetate, dried off, and then passed through a bath heated to about 160° F. containing a little sodium phosphate. Prepared pieces of cloth were dyed with various colouring matters, and finally soaped. The colours yielded were as follows:—

Alizarin.—Full red, duller, and of a bluer shade than when alumina acts as the mordant.

Alizarin Orange.—Full orange, considerably redder than with alumina.

Cœrulëin and Alizarin Blue.—Dark green and full blue respectively, very similar to the colours produced on an alumina mordant.

Preparation of Persian Berries.—Brownish orange.

Tannic Acid.—Buff; very like an iron buff.

Logwood Extract.—Dark grey—almost black.

[*In reply to a question by* Mr. W. Thomson, *as to the mode of carrying out the alizarin test for alumina,* Mr. Barnes *continued*]: The well-washed precipitate is mixed with water, one drop of a mixture of alizarin and water containing not more than 1 per cent. of pure alizarin is added, and the whole boiled for a short time. The precipitate, if consisting of hydrated alumina, assumes a bright red colour, which is more conspicuous if the precipitate be allowed to subside; if one drop of weak acetic acid, containing about 1 or 2 per cent. of the pure acid, is then added the colour will not be destroyed. If a red-coloured fluid has been formed owing to the presence of traces of alkali, the addition of the acetic acid immediately destroys the colour. I have sometimes made use of this test to remove any doubt as to whether a precipitate was alumina or hydrated silica. [*In reply to a question by* Mr. Sims, *as to whether the production of the colour was due merely to the oiling*]: When pieces of the oiled cloth containing no titanic acid were heated with the dye materials, there were practically no colours formed. I have, moreover, obtained similar colours on yarn which had not been submitted to any oiling treatment.

Newcastle Section.

Meeting held April 23, 1885, in the Durham College of Science.

DISCUSSION ON MR. WELDON'S PAPERS READ AT THE LAST MEETING.

Dr. Hewitt: There is one point, which in justice to English industrial chemistry should be stated, and that is in reference to a remark which Mr. Weldon made as to the possibility of making strong bleach from dilute chlorine. He omitted, unintentionally, I am sure, to state that without any mechanical means whatever, that question had been solved in England more than ten years ago. It will be known to every member that about that time Mr. Henry Deacon invented a direct process for the manufacture of chlorine by the decomposition, or, as I should prefer to call it, the combustion of hydrochloric acid with air at a high temperature in presence of a copper salt. That process yields an extremely dilute gas; it has been successfully worked, and it has been clearly established on a manufacturing scale that strong bleach can be made from very dilute chlorine. In order to give some idea of how dilute the chlorine may be, I have myself frequently made bleach testing 36 to 37 with a gas containing 26 or 27 grains of chlorine per cubic foot of inert gases—a degree of dilution far greater than any that M. Péchiney is likely to have used. I think it is due to the memory of Mr. Deacon that this should be stated.

ON A NEW FORM OF CHLORIMETER.

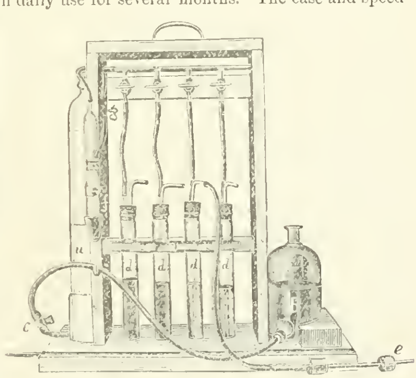
BY J. FLEMING STARK, F.C.S.

Special attention has lately been directed by Her Majesty's Inspector under the Alkali Acts, to the amount of chlorine left unabsorbed in the chambers in the manufacture of bleaching powder. A notice thereon by Mr. Fletcher will be found at p. 39 of his last annual report. Immediately following the publication of that report, a system of testing was instituted at Messrs. Tennant's Works, at Hebburn, which has been continued ever since, and by which, each day, the amount of chlorine remaining unabsorbed in each chamber is ascertained prior to packing. The process first used was as follows:—40cc. $\frac{N}{10}$ arsenite of soda solution was introduced into a bellows aspirator of 0·1 cubic foot capacity; 0·1 cubic foot of gas was then drawn from the bleach chamber, the aspirator well shaken, and the contents then carefully washed out. The amount of arsenite of soda left unacted on was then determined by titration with $\frac{N}{10}$ iodine solution, and the grains chlorine per cubic foot of gas calculated therefrom. A careful examination of this method of testing was made, and its accuracy satisfactorily established.

A short time after this, Ballard's chlorimeter, as exhibited by Mr. Payne at the December meeting of this Section last year, was introduced on the Tyne. This apparatus consisted of a glass jar with attached indiarubber finger-pump, and was a modification of the apparatus described in 1864 by the late Dr. Angus Smith at p. 48 of his first annual report.

The process used was a development of Dr. Angus Smith's "minimetric system or method of analysis." A known quantity of hyposulphite of soda was introduced into the jar along with a little iodide of potassium and starch liquor. Gas from the bleach chamber was then drawn through the solution till a blue colour was obtained. The printed instructions, along with table for calculation of results, are published by Messrs. Mawson & Swan. The results obtained thereby, however, I have found to be considerably under the actual, and this, in view of the possibility of future legislation on the subject, has to be carefully guarded against, as thereby an erroneous idea might be established of the degree of absorption practically obtainable in ordinary working. As regards the reason for the discrepancy referred to, I have not investigated.

Returning then to the bellows test described above, an extended experience proved it to be, though accurate in careful hands, rather cumbrous in working. Each test necessitated a journey from the laboratory to bleach chambers and back again, thus entailing too great an expenditure of time. I accordingly designed the apparatus as shown below, which has now been in daily use for several months. The case and speed



with which it can be worked, and the close degree of accuracy of the results obtained thereby, form my excuse for bringing it under your notice this evening. It consists of a burette *a* for measuring the gas. This is filled with water and connected by indiarubber tubing with the reservoir *b*. Between the burette and reservoir, a tap *c* is inserted, having two holes drilled through the plug at right angles to each other, one of large diameter and the other of small diameter. This admits of either the full flow of water through the tube while the burette is being filled with water, or of a restricted flow while gas is being drawn through the solutions. The four tubes *d*, *d*, *d*, *d*, contain solution of iodide of potassium in water, and can each in turn be brought in connection with the measuring burette by means of the glass taps shown. These absorbing tubes have each two tubes inserted through an indiarubber cork. One tube reaches nearly to the bottom of the solution, and is contracted at its lower end so as to break up the bells

of gas, and at its upper end connected with the interior of the bleach chamber by indiarubber and glass tube *e*. The second tube just goes through the cork and connects with the burette. Between the absorbing tubes and the burette a small wash-bottle *f* is fixed containing solution of iodide of potassium and starch. Between the wash-bottle and burette there is a two-way tap *g*, which admits of the air in the burette being forced out in refilling without having to pass backwards through the wash-bottle.

In using the apparatus, 387·7cc. of gas are drawn through the solution in one of the absorbing tubes. Certainty of the absorption of all the chlorine is obtained by the solution in the wash-bottle remaining colourless. The contents of the tube are then carefully washed out into a beaker and titrated with $\frac{N}{10}$ arsenite of soda solution. The number of cubic centimetres of this solution used multiplied by two gives the grains of chlorine per cubic foot of gas in the chamber.

ON A PRACTICAL METHOD FOR RECOVERING TIN FROM TIN SCRAP BY ELECTRICITY.

BY JOHN HENRY SMITH, PH.D. (ZÜRICH),

Associate of the Royal College of Science, Dublin.

Owing to the vast accumulation of the above-mentioned material in canister, button, and other manufactories where tinned iron plate is extensively employed, considerable attention has been devoted to the utilisation of the same, chiefly with a view to the recovery of the tin, either in the metallic form or that of one of the various salts of tin used in commerce.

It would be interesting and amusing, although not instructive to an equal degree, to glance at the various methods, patent or otherwise, which have been suggested from time to time to effect this purpose. The separate actions of acids, alkalis, and chlorine gas have been utilised; friction and fusion have been resorted to; and more recently electricity has been pressed into service.

Of these methods I am only aware of three which have been employed on any large scale—viz., dissolving in a mixture of hydrochloric and nitric acids, and subsequent precipitation of tin by metallic zinc; treatment with caustic soda and litharge, forming stannate of soda; and the formation of tetrachloride of tin by the action of dry chlorine gas.

The last-named process is worthy of special mention. It has been described by Prof. Lunge in his report of the chemical section of the Swiss National Exhibition, held in Zürich in 1883.

Some time ago I was requested to recommend some practical method for the utilisation of these tin cuttings, in a district where they could be collected in large quantities. After reading all the literature at my disposal relating to the subject, I was induced to make some experiments, and amongst others, actuated by a knowledge of certain electrolytic processes employed for the precipitation of metals from their ores, I tried the effect of a current of electricity in passing through an acid solution in which a quantity of cuttings were suspended forming the anode, a copper plate serving as cathode. These experiments proved that not only is tin dissolved at the anode, but that it is also deposited in a pure form at the cathode, very soon after the commencement of the action. After continuing these experiments, and making the necessary calculations, I came to the conclusion that this might form the basis of a practical method for the recovery of tin from tin scrap on a large scale.

I recommended that a trial should be made of this process; this was undertaken; the ceremony of obtaining a patent was duly observed, and I was intrusted with the supervision of the erection of the plant, an account of which, and of the results obtained therefrom, I now propose to give you in a brief form.

Although ignorant at the time, I am now aware that at least four English patents have been granted for the same object, effected by very similar means; still, as there are important differences in the process about to be described, and especially as, to the best of my knowledge, it was under my direction that the first plant was erected for the employment of an electrolytic method on any large scale, I venture to hope that the following details may interest the members of our Society:—

General.—The cuttings with which we had to deal varied considerably in value. Some of the thicker ones contained little more than 3 per cent. of tin, while some of the thinner kinds contained 8 or 9 per cent. I considered 5 per cent. as about an average. The quantity obtainable was calculated at about 6 tons per week, and the plant was designed to accommodate that quantity, charging twice a-day. The iron was designed to be converted into sulphate, a large quantity of which could be disposed of at a high price; the remainder was to be converted into "iron mordant"; the tin was to be converted into stannous chloride, and other salts of tin employed as mordants, and largely used by the dyers of that neighbourhood.

Source of Electricity.—No doubt could exist as to the best source for the production of such a strong current as that required, the difficulty was to select the dyamo machine which would be most suitable for the purpose. The machines manufactured by Siemens and Halsk of Berlin had been very highly spoken of as yielding good results in the precipitation of copper on a large scale at Oker in Germany. This firm was appealed to, and one of their small machines was recommended, which, although calculated to perform only about one-half the work required, was deemed sufficient to commence with. This machine is numbered C_{18}, and it is stated to give a current of 240 Ampères with an electromotive force of 15 Volts, and an expenditure of 7 horse-power. (Of course this is considerably higher than the calculated power required.)

Baths.—From the given capacity of the machine it is easy to calculate that the best result would be obtained, without danger of over-heating the machine, by arranging the total resistance to be equal to $\frac{1}{16}$ Ohm. As the subject of the resistance of various liquids to the passage of the electric current has been so imperfectly investigated, and data respecting other factors being likewise unobtainable, it was impossible to determine the best form, number, and arrangement of baths for the purpose in question. The best plan was evidently to make the resistance of each bath as little as possible, consistent with facility of working, and then to arrange them parallel, or in series, or both, so as to include the resistance mentioned above. Eight baths were decided upon, These were made of wood, lined with indiarubber, and each had the following internal dimensions. (I preserve the metrical measurements, not to shirk the trouble of converting them into English equivalents, but because I think every English chemist should be as familiar with the metric system as with our national system of weights and measures.) Length 150cm., breadth 70cm., depth 100cm. The thickness

of the wood was 5cm., that of the indiarubber 3 to 4mm. Each four baths were formed by the division of one large tank, 3m. × 1½m., and the two tanks were firmly secured by iron bolts running from side to side. Placed longitudinally they occupied exactly the breadth of the building, and they were fixed at the end of the same, at an elevation of one metre from the ground. In front was a platform, at one side of which was a door for the admission of the cuttings, after being washed and packed. The dynamo was situated in the engine room just behind the baths, and communication was made by two copper cables passing through a hole in the wall. At either side wall, and on a level with the baths, was a dissolving tank capable of accommodating half the cuttings after the removal of the tin. A little farther on, and nearly on a level with the ground, were the evaporating down tanks. The crystallising tanks were situated beneath the ground level, so that the solution could be run off from one stage to another without any pumping arrangement.

Anodes.—These, of course, were composed of the tin scrap. Baskets were obtained to pack the cuttings in. These, at first, were made of wicker-work, but as they were too flexible, and soon rotted by the action of the acid, their place was supplied by strong wooden baskets, whose sides were formed of stout upright wooden bars, 2cm. thick, with spaces between them sufficient to allow the solution to circulate freely, while preventing the exit of the scrap. The internal dimensions of the baskets were:—Length, 120cm.; breadth, 30cm.; depth, 85cm. Great care was required in packing the scrap, because, if it were packed too closely, the metallic surfaces thereby united, and preventing the circulation of the electrolyte between them, necessarily retained their coating of tin. These baskets held from 60 to 70kilos. of the scrap, the 8 being capable of accommodating about half the total quantity required. Long and narrow strips of the same material were employed to complete the communication with the conductor. As the resistance of iron to the current is comparatively great, a large number of these were required to prevent excessive heating. At one end they were soldered together, and connected with the copper conductor by means of binding screws; the other extremities were distributed throughout the scrap.

Cathodes.—Copper plates were employed. These had a thickness of 1½mm., were 120cm. long, and 95cm. in breadth. There were 16 in all, two for each bath, placed one on either side of the baskets. To keep these thin plates of copper as plane as possible, each was surrounded by a framework of copper rod of square section. They were coated with tin to prevent corrosion, as well as to avoid solution by any accidental reversal of the current. These plates rested in grooves at the sides of the tanks, placed at a distance of 10cm. from the sides of the baskets. They were provided, as also were the baskets, with indiarubber rollers extending to the sides of the baths, enabling them to be raised out of the same with ease, and without injury to the indiarubber coating.

Electrolytes.—Dilute sulphuric acid formed the electrolyte. This was employed, not only on account of its comparatively small resistance to the current, but also because it was convenient to turn the solution into the sulphate of iron tanks, as soon as it became saturated with that salt, and all the tin had been precipitated from it. Commercial acid of 60° B. was diluted with 9 volumes of water.

Above the tanks was a pulley arrangement for raising the baskets and plates out of the baths as required; there was also an arrangement of levers and eccentrics constructed, whereby the baskets were kept in gentle motion in the baths, thus exciting circulation in the liquid, and tending to prevent polarisation. The horizontal axis upon which the eccentrics were disposed made about two revolutions per minute, thereby raising the baskets a distance of about 5cm. Levers were fulcrumed into the wall, these passed over the eccentrics, and at their extremities ropes were fixed communicating with the baskets.

The current was conducted by thick copper wires of several plies. Although already coated, they were enclosed in indiarubber tubing as an additional protection.

One of Crompton's indicators, registering up to 250 Ampères, was obtained for measuring the strength of the current, and detecting flaws or breakages in the same. Some such instrument is invaluable for such work, and this proved very reliable.

Results obtained.—The arrangement of the plant having been detailed, it remains to give the results of the working of the same. The critical point had been arrived at; the working capacity of the structure was to be determined; that which calculation could not indicate was about to be demonstrated. Acting in accordance with the principle, "Aspire high," the baths were first arranged in *series*. The connections being complete, the engine of 8 horse-power was set in motion; the dynamo increased rapidly in speed, while the needle of the indicator followed tremulously until it stood vacillating within a few degrees of 240 *Ampères*, the dynamo then making about 900 revolutions per minute. Thus the most economical conditions of working had luckily been hit upon; the machine bore the current bravely, showing no signs of overheating.

Quality of Tin deposited.—This was at the first of a spongy nature, owing to the great acidity of the bath. Soon, however, it began to be precipitated in a more dense, extremely fine, granular, and partially crystalline state, which indeed was preferable, as it fell to the bottom of the bath, and was not in danger of forming a communication with the anode. I will not say that the tin was "chemically pure," but it was purer than commercial tin, and, when thoroughly washed, contained no trace of iron. It fused readily, and almost completely, and that without any addition, provided it had previously been thoroughly washed and dried. The rapidity with which it dissolved in hydrochloric acid was not to be compared to the slow action of that liquid upon granulated tin, and this rendered it peculiarly suitable for the production of stannous chloride.

Quantity of Tin precipitated.—From the data already given, the theoretical amount of tin deposited can readily be calculated. The electro-chemical equivalent of tin as a dyad, compared with silver, is $\frac{117{\cdot}8 \div 2}{107{\cdot}66} = 0{\cdot}546$, and this is equivalent to the precipitation of $67{\cdot}65 \times 0{\cdot}546 = 36{\cdot}94$m.gms. of tin per minute per Ampère. For 240 Ampères, working through 8 baths arranged in series, we obtain a total precipitate of $\frac{36{\cdot}94 \times 240 \times 8 \times 60}{1{,}000{,}000} = 4{\cdot}25$kilos. per hour. As a matter of fact, little more than half this quantity was obtained, the discrepancy being due to part of the current being absorbed in dissolving the iron as well as the tin, as soon as the former began to get bare. This, together with the natural solution of the iron in the acid, led to the rapid accumulation of sulphate of iron in the baths. The acid here employed took about seven weeks to become saturated. On analysis, the baths were found to vary in a very remarkable manner, first one and then another containing the largest quantity of iron. The tin, on the contrary, remained very constant in amount, both in the

individual baths and in the total, the average being 1·5grm. per litre. Pure tin was deposited until the acid was saturated and no more tin was present in solution, then hydrate of iron began to form. This might be avoided for a time by the addition of more acid, but it was better to run the liquid into the "green vitriol" tanks, and add fresh solution. It was not at all necessary to continue the action of the current until all the tin had been removed; in fact, after a certain time, the action on the iron was even stronger than that on the tin. It was found in practice that, after the passage of the current for the space of 5 or 6 hours, the quantity of scrap referred to was sufficiently free from tin to be dissolved in the sulphate of iron tanks with the greatest ease; the tin remaining unacted upon in the presence of the large excess of iron always provided for, and it was not difficult to recover that tin, and utilise it with the rest.

Cost of Plant and Expense of Working.—These, of course, would depend upon the neighbourhood fixed upon, and other circumstances; but, in any case, they would be little compared with the value of the tin capable of being recovered. I think I have given sufficient details for any one to be able to calculate approximately their amount for any particular locality. Generally, this scrap is obtained for a mere nominal sum, frequently just for the expense of transport. One stoker and two or three labourers would be quite sufficient to work three tons per week, using one of the small dynamo machines manufactured by Messrs. Siemens Bros. The three cwt. of metallic tin obtained therefrom, at £3 18s. per cwt., will compare favourably with the cost of fuel necessary to maintain the production of 7 or 8 horse-power, wages of workmen, interest on the plant, and occasional repairs. If it were worked on a larger scale, and the tin and iron further worked up into salts, as in the instance detailed, the profits would be increased in a much greater ratio. When we consider that in Paris alone 3000 tons of this scrap are produced annually, it is no unimportant matter to determine the best method of utilising it.

Advantages of this System.—In addition to the consideration of economy, this method possesses advantages which are well worthy of attention, especially where sulphate of iron and "iron mordant" are marketable products. As has been observed, the tin is precipitated in a pure form, and in a state of fine division. It may, therefore, be either fused and sold in the metallic form, or it may be converted into stannous chloride, or other salts, for which it is exceedingly well suited, owing to the ease with which it is dissolved. In the process in which the scrap is acted on by chlorine gas, no choice exists as to the form in which the tin shall be sent to the market, tetrachloride being the constant product. The same remark applies to the method where caustic soda and litharge are employed, and in other respects this latter method has little to recommend it, judging from my own observations. The other process which I mentioned is also unsatisfactory. In employing a mixture of hydrochloric and nitric acids, considerably more iron than tin is dissolved, and when the tin is precipitated by metallic zinc, the contamination of the chloride of iron with zinc chloride renders it of little value. I do not claim perfection for the method I have advocated. It is capable, however, of considerable modification; and I am sorry I have not been able to follow the matter up as I should have liked. A better electrolyte could doubtless be found; probably a solution of stannous sulphate would be the best. I think, however, I have proved that this process is practical, simple, and economical; and further, that it presents the additional advantages of purity of product and variety of utilisation, thus rendering it well worthy of a wider application.

DISCUSSION.

Mr. GATHERAL said: This question of the recovery of tin was one to which a great deal of attention had been devoted, there having been taken out since 1857 no less than about forty English patents on the subject. The question of cost was the thing on which they had chiefly broken down, and he feared this would be the case, too, with Dr. Smith's process if attempted here. In this country the mere cost of collection of tin scrap often amounted to 25s. or 30s. per ton.

Dr. SMITH said that the cost of the tin scrap at the locality spoken of in the paper was only 2 francs per ton.

JAMESON COKING PROCESS.

BY J. JAMESON.

I HAVE been asked to say something to-night as to the coking process associated with my name. I admit that some explanation is required as to its position. A little more than a year ago, and indeed up to a much later time than that, it was considered a highly successful process, and one of immense importance to the coke and coal trade everywhere. At the present time little is heard of it, and that little is sometimes, unhappily, not satisfactory.

In regard to the truthfulness of representations made by the holders of my patents, there is not a word to retract. The results obtained were published far and wide; coals were carried to Felling from nearly all parts of the country and coked in the ordinary oven, usually in the presence of the owner or his representative; the products were carefully weighed and measured; many independent analyses were obtained, samples were sent in all directions, and the fullest inquiry was courted.

When the process was practically adopted, it fell into good hands. Messrs. Bell Brothers converted three ovens, and after some experience with them, seven more; then, with a further experience of many months, another range of seven. The Weardale Iron and Coal Company converted three, then added seven more, and after many months' trial, made a new conversion of twenty, with plant adequate for considerable extension. The results of these trials were reported to us as follows:—That the cost of the process was less than one penny per ton of coal coked; that the yield of coke was increased; that the time required in the oven was shortened; that the quality of the coke was improved as regards sulphur; and our coke, being carefully tried in the blast furnace by itself, was pronounced quite equal to the best Beehive coke. No wonder the use of the process was extended, and that we had very soon installations in a number of different places.

The results, unhappily, were in many cases by no means such as we had anticipated, and complaints began to rise, and, as time went on, to increase. The defects discovered, not of course all at one place, but some at one place and some at another, were the following:—

The yield of ammonia was almost *nil*. The yield of oil was much less than was expected; its quality was depreciated; the suction pipes stopped up; the scrubbers became clogged with a pitchy oil; the passages below the oven floor became filled up with coke dust, or the perforations in the brick bottom through which the gas should pass, closed up; the gas became unburnable or explosive. The Directors of the Company found themselves embarked upon a sea of troubles with no autocrat to direct, and no absolutely certain programme to follow.

I am, I confess, greatly tempted here to indulge in some personal explanations; but they would have little general interest, if any, and I refrain.

The Directors of the Company did not cease to believe in the process. Most excellent results had been obtained, and the difficulties arising appeared to be mechanical and not inherent in the invention itself. The falling off in results for the reason that it was due in one place to one cause, and in another place to another cause, was not unhopeful; and without dividing a penny, the Directors (being at the same time the largest shareholders) have been content to spend, in the prosecution of the enterprise of the Company, upwards of five thousand pounds, independently of the cost of all preliminary experiments.

Now, as to the present position of affairs. I do not propose to take you through all the tedious steps of our discoveries. Alterations in ovens or apparatus involve the expenditure of considerable time, and often a much longer time is required for practical demonstrations of their effect; but, perhaps, the longest time of all is occupied in localising the exact cause of failure where there may be several causes.

The first and great cause of all our trouble, after many experiments, was conclusively proved to be ingress of air at the oven bottom, and the first requisite to success, therefore, is that the oven bottom be air-tight, or as nearly so as possible. This point was strongly pressed in all our circulars and in all our directions for installation, but, as it proves, not sufficiently so. Any ordinary building of bricks and fireclay or (unless carried to both a great depth and width) of bricks, fireclay, and tar, becomes after use porous, and admits air. The effect of leakage of air is extremely bad in many ways. The air is heated in its passage through the hot brickwork, and meeting with the warm gas from the oven (dependent upon degree of admixture and temperature) it decomposes the ammonia, and the oil or it makes an explosive gas; or the air may burn in the gas atmosphere, just as gas does in air—it produces a heat in the pipes which is very undesirable, causing a distillation of the oil deposited on the sides of the pipe, with the result that the lighter fractions of the oil are carried forward with the gas, and the heavier part is formed into pitch on the pipe, and gradually stops it up. There is a further injury caused by the ingress of air—namely, that all useless air tends to carry away ammonia and oil, by hurrying the gas dealt with through the scrubber and condenser. If the gas be mixed, for instance, with its own bulk of air at equal temperature, it is clear that the condensing apparatus must be double the size, and that scrubbers and exhausters possess only half the efficiency they would have if the air were excluded. A simple method of discovering the tightness of an oven bottom is to cover the whole of the perforated floor with papers wet with oil, and then to apply considerable suction, and estimate the quantity of air passing. But, as defects may arise in this respect at any time, it is also of great importance to have a simple means of ascertaining how much gas is passing from every oven to the main when in regular work; and to accomplish this we put a regulator valve in the pipe of each oven between the oven and the main. This regulator is a valve so marked as to indicate exactly the amount of opening through it, and there is a syphon water-gauge coupled to the pipe at one end on one side of the regulator, and at the other end to the pipe on the other side of the regulator, so that the indicated difference of level shall show the exact pressure tending to pass gas through the restricted opening. Within very narrow limits, this enables us to estimate the exact quantity of gas passing from each oven.

If from a 5-ton oven, burning its charge in 72 hours, there is a passage of gas of about 1000 feet per hour, with a good suction on the oven, it may be presumed that the process is working well; but if the passage of gas be much more or less than this it points to some defects which should be investigated and remedied.

Next to the tightness of the oven bottom, I think I should attach importance to the construction of the oven floor; and the best floor, in my judgment, is one formed of alternate firebricks and T irons; the bricks being shaped so as to take in the T iron, and form a level floor. I show a piece of T iron which has been in an oven continuously worked for four months. It is practically as good as new.

I show a drawing of the special brick and of the oven floor with T irons in place. To provide for expansion and prevent the T iron from rising into the charge, we cut these into pieces not more than 18 inches long, and bevel the ends as shown in the drawing, so as, while affording room for expansion, to prevent actual opening for the passage of coal into the channels below; or the floor may be constructed in accordance with plan No. 2. The T irons prevent an action which has caused a great deal of trouble—namely, when the openings through or between the bricks enlarge downwards, as they must do to prevent stopping up, any chipping of the top makes an opening equal to the size of the enlargement at the depth to which the chip extends. The heavy rakes in use for drawing coke chip the bricks, the openings become much too large, and coal and coke dust get down and impede or stop up the passages below. The T iron, however, will bear a heavy blow of the rake and distribute it on a large solid body of brickwork so as to do no harm to it.

Next in importance to the points already referred to, I attach value to an improvement effected by a slight cooling of the gas of each oven separately before passing into the main.

It is very easy to reduce the temperature of gas at 400° to 150°, a very short pipe will do it; but if gas at 400° be mixed with gas at, say, 150°, so as to make the resultant temperature 160°, it requires a great surface of pipe to extract the 10° thus added and bring the temperature to 150°. There is, however, a still stronger reason for the partial cooling of the gas of each oven separately—namely, that gas and products of different quality come off at different periods of the process, and if hot gas from an exhausted or nearly exhausted oven be mixed with rich gas from a half burned oven, the products in the latter may be decomposed; the oil, which from this half-burned oven is condensible, may be so acted upon that part of it is converted into permanent gas, the remainder is injured in quality, and the ammonia may be wholly lost. With cooled gas, however, this action is stopped.

I show a drawing of the arrangement of the ovens showing the cooling pipes, details of the regulator valve, the suction pipe of each oven, and its cleaning arrangements.

I think it is well to condense the steam used for the steam jet, so as both to recover the oil and ammonia brought down by the steam, and at the same time to make the gas available for burning; but, of course, if a mechanical exhauster be used this is not necessary.

The modifications I have referred to have been practically applied at one installation, as follows. Formerly half-an-inch suction on the oven bottom overheated the pipe to the extent of sometimes making it red-hot, and as the chimney draught was a quarter-inch, the real pull on the gas was necessarily exceedingly small. With half-an-inch of suction the quantity of gas and air passing from the oven was

equal to 80,000 feet per ton of coal coked, by far the larger portion being, of course, air. Now, with the same oven, $3\frac{1}{2}$ inches suction gives a passage of gas equal to less than 12,000 feet per ton. The temperature in the oven pipe with this great suction is usually under 200°, and rises only to 400° as the oven gets nearly burned off. The yield of oil is increased to four times what it was, and, in fact, both in ammonia and oil the Felling results have been obtained. The scrubbers, cooling pipe, and steam jet, are equal to more than six times the work they could formerly do; they can now operate six ovens instead of one with equal efficiency, and the quality of the oil is greatly improved. There is no possibility of burning the oil by reason of defect in one oven of the range; and any defect in stoppage of floor or leakage of air is at once apparent. The attention required is diminished, and I confidently believe that the application of the remedies devised will meet our troubles at every installation. That is to say, there is not any defect which has arisen, at any installation, which is not, so far as I know, met and covered by the modifications introduced. Experiments are still going on with a view to discover the best and cheapest means of making a really air-tight bottom, but as we can safely go to a depth at which the temperature never rises above a dull red, there cannot possibly be any permanent difficulty about it.

DISCUSSION.

Mr. JOHN PATTINSON was interested to know that the modifications spoken of were making the process a working success: he asked whether the sulphate of ammonium was recovered at any installation, and to what purposes the oil was best applied. Mr. Jameson was also asked the strength of the liquors yielded.

In reply, Mr. JAMESON said: The ammonia is not worked up into sulphate at any of our present installations. The largest number of converted ovens at one place is 54, coking about 600 tons of coal per week; these ovens are not yet modified in accordance with the arrangements described in the paper; the coal used is one yielding only small results, and the yield of ammonia is not large enough to warrant the erection of sulphate plant. The quantity of ammonia yielded depended on the coal, and varied from 2 or 3lb. to about 15lb. (expressed as sulphate) per ton. As to the oil, Dr. Armstrong, of London, is going to read a paper at the Iron and Steel Institute meeting shortly, which will I believe deal with the whole question of its nature and uses. Dr. Armstrong told me that he finds it in a very marked degree a low temperature product, and hence especially adapted for conversion into other forms by higher temperature. He suggested its application as a source of illuminating gas, and that fractions not suited for other purposes should be used as a liquid fuel for steam-ships. A good deal has been used for creosoting and found very good for the purpose. The strength of the ammonia liquor varied from 2 to 5oz. per gallon.

THE ST. BEDE PATENT DECOMPOSING FURNACE.

BY W. L. RENNOLDSON.

THIS furnace, which is the invention of Mr. Thos. Larkin of East Jarrow, has been designed for the manufacture of sulphate of soda, hydrochloric acid, and other substances. In its arrangement every attention has been given to the important requirements of the present time, which are, capability to make salt-cake of first-rate quality, and to yield the HCl in the largest possible quantity, and this of high density (so as to allow of the best results being got in the bleach department), while at the same time to admit of the escaping flue-gases being readily maintained within the standard limit of acidity.

These desiderata are all accomplished with this furnace, and not only accomplished, but with remarkable economy under every item—viz., labour, fuel, vitriol, first cost and maintenance. In its general character the furnace is not such a radical departure from the hand-worked furnace as other mechanical decomposers are, the aim having been to retain the really efficient features of the best hand system, and combine with these the several improvements which constitute the invention, and which were actually desirable.

The plant consists, in the first place, of an ordinary pan situated so that the charge of salt is dropped in from a wagon on an overhead tramway, and it (the pan) is fired by the waste heat from the roaster.

The roaster is of the close or muffle style, but with a specially low and perfectly flat inner roof (or arch), consisting of sections of iron plates supported in a very novel manner, and the space between it and the upper arch, which is also nearly flat, is divided into independent transverse compartments or channels.

The heating of this roaster is effected by a double series of small fires; one series heats the bed from its under side, the other heats the roof. Each fire has its own flue across the furnace, and afterwards all these small flues lead into a main one, from which all or any portion of the waste heat can be directed under the pan.

The mechanical appliances for working the batch in the roaster, are a vertical shaft, and horizontal radial arms with scrapers, and being very strong—*i.e.*, strong in the proper place, but by no means ponderous—are very serviceable and efficient.

A small steam engine transmits the power from below, and the whole arrangement works smoothly and silently.

The substitution of steam-power for manual labour for working the batch in the close roaster, and the protection of every part of the steam-worked tools from the direct action of the fire, are special features of the invention. And the adoption of several small fires in place of one enormous, and more or less unmangeable fire, is an improvement of the greatest advantage.

The multiplication of the sources of heat leads to an even heating of the whole furnace, and, as the coaling and cleaning (scarring) is done at intervals, and at one fire at a time, the temperature of the whole furnace can be maintained with great regularity, and thus the great cause of destruction to the structure—*i.e.*, expansion and contraction—is largely reduced. And as each flue, under the bed and over the arch, has its own fire, and each flue has a damper, it becomes an easy matter to manipulate the heat in any way, or even to entirely lay off any section of the arch, in the event of a failure occurring.

These flues being on the "flash" system (in contradistinction to the usual "wheel" or return system) a very slight draught to the chimney suffices, so that any leakage would not be of acid gas to the chimney, but of smoke to the condenser, owing to the (with this furnace) *undoubted* stronger draught to the condenser than to the chimney; however, the useful provision above mentioned effectually provides against leakage in either direction.

The fact that all the stirring and raking of the batch and the evolution of its HCl takes place with *closed working doors*, is a very great advantage in many ways—direct and indirect, more especially when coupled with the fact that the roaster is a close one.

There is the highly important one that it renders it a matter of ease to obtain practically all the hydrochloric acid in a highly concentrated state without any costly ranges of cooling pipes, or extravagant condensing space; this is a considerable saving in cost for plant and its maintenance, and the cost for *wash towers* and for their supply of water are entirely saved. The high strength hydrochloric acid means a less volume of itself, and of the still liquors, and as the loss of HCl, as free acid, in the still liquors is in direct proportion to their volume, there is a greater utilisation of the acid, and consequently a larger production of bleach per ton of salt decomposed.

From the same cause there is a saving of chalk or limestone for neutralising, while less still, etc., room and steam suffice for working such liquors.

Another advantage connected with the closed working doors is in the matter of the usual escapes of acid vapours about the furnaces—*i.e.*, the "*low level escapes*"—which are the cause of much anxiety in many neighbourhoods; with this furnace such escapes are almost unknown.

This satisfactory state exists partly from the doors being closed, and also from the reason that a much stronger draught to the condensers is used with these furnaces than with hand-worked ones.

A strong draught *on hand roasters* is the cause of several evils; when the working doors are open, as they must be to a large extent, the inrush of air rapidly cools the roaster, and heats the condenser, and so interferes with efficient condensation.

Then, again, the practicability of working with closed doors and strong draught prevents the possibility of any acid gas leaking into the chimney gases through any crevice that might exist in the arch, etc.

This arrangement of furnace also benefits the workmen to a very considerable extent. The drierman is relieved of nearly all the punishing nature of his work. The steam-worked tools relieve him of the hard labour, heat and gas he had to bear with the hand furnaces, and the closed doors and strong draught keep the air about the place free from acid; and the attending to the several small fires does not give him the severe scorching that the ordinary large fire does; and when he draws the batch, it is so well worked and evenly fired that not even then is he troubled by gas.

Even the pan-man is much benefited, as he is allowed to have a stronger draught than formerly, when there was always a fear of drawing dangerous heat, etc., from the roaster through his open, or perhaps leaky partition damper. He is also relieved from the scorching which the ordinary pan-fire gave him.

The sulphate can readily be made of any strength and with great uniformity, and this uniformity of composition and of physical condition, being free from hard lumps and fine without being dusty, renders it highly suitable for the manufacture of alkali and of glass.

The following is a statement of results:—

RESULTS OF WORKING BY THE ST. BEDE CHEMICAL COMPANY, NEWCASTLE—AVERAGES OVER LAST THREE MONTHS.

(Three furnaces are now in constant operation.)

Salt decomposed per furnace per week (six days) (80 tons have been done in a week of six days)......... 72 tons
Sulphuric acid consumed (on weight of damp salt as received)......... 78 per cent.
Sulphate (salt cake) made .... 110 per cent.
Test of sulphate, 0·4 acid .... 1·3 per cent. salt
Test of gas from pan and roaster at the condenser inlet .... 175 F.
Test of gas from pan and roaster at the condenser outlet .... 0·19gn. HCl per cubic foot
Test of gas, etc., in chimney... 0·07gn. HCl per cubic foot
Test of hydrochloric acid produced ...... 29° T. at 60 F.
Bleaching powder, 1 ton obtained from each... 46cwt. salt

	Per Ton Sulphate s.	d.
Labour (all at and about furnaces)	2	0
Labour since reduced, now working at	1	9
Steam, fuel and labour for.........	0	1¼
Fuel at pan and roaster, 7½cwt. small coal	1	3

Repairs.—During the fourteen months the system has been at work there have been no appreciable repairs, no renewal of arms, nor of bridge, arch, or casing of either pan or drier fires, only replacing of worn scrapers.

DISCUSSION.

Dr. Hewitt said that he had seen the furnace at work that morning, and observed that both the method of firing and construction of the arch or roof were novel. He considered that the idea of heating with a number of small fires with separate flues was a great improvement on the one large fire system, because the latter caused great intensity of heat in a part only of the furnace, with consequent unequal expansion and contraction. He received with reserve the statements as to cost of maintenance, owing to the short time during which the furnace had been at work; but at the same time he thought that its special construction was likely to conduce to economy in that direction. As to salt cake, he preferred its being made in two operations, as in the pan and roaster of the hand-worked furnace. But in this, mixing had to be done by hand, and the quality of salt cake produced depended on the skill of the workman. Moreover, hand mixing necessitated open doors, leading to both influx of air and escape of gas. Open mechanical furnaces, intended to replace the old "pan," had never seemed quite satisfactory to him, owing to the dilution of the gas with air. Gaskell and Deacon's, and Gamble's plus-pressure furnaces had been intended to meet the objections to the second part of the operation, inasmuch as they were "close," and permitted little, if any, dilution of the evolved hydrochloric acid. But Mr. Larkin had added to the old pan a mechanical muffle, in which thorough incorporation was effected by a mechanical stirrer with closed doors, thus effecting better condensation, and avoiding low-level nuisance. The stirrer is not exposed to a very high temperature, and its wear and tear is reduced to a minimum. Altogether, both as regards fuel, condensation, and make of bleach, he thought very highly of this furnace. Having regard to present circumstances, which rendered it desirable to make a maximum of bleach with a minimum of soda, and to obtain a more condensed, and thereby stronger gas, there was no doubt that Mr. Larkin's furnace was a step in the right direction.

Mr. Stuart: It would have added materially to the value of Mr. Rennoldson's interesting paper, had he mentioned the particular form of decomposing furnace over which he claims advantages for the Black and Larkin furnace, and I think it would have been well had he selected for comparison the furnace which in his opinion best suits the requirements of the present day. All other things being equal, as to cost of plant and sulphate, combined with satisfactory quality of the product, that furnace is the best, in the present condition of the Leblanc process, which produces a ton of bleaching powder

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from the least quantity of salt. On the one hand we have the Jones and the Mactear mechanical decomposing furnaces, and on the other the Deacon and the Gamble plus-pressure hand furnaces. In discussing the merits of the Black and Larkin furnace to-night, it will be obviously necessary to select for comparison from these four, the furnace which is best adapted to our present requirements. The Jones and Mactear furnaces have each proved a mechanical success, and the sulphate produced by them is of excellent quality. Per ton of salt decomposed, however, the cost for these furnaces is enormous, and in connection with the now all-important question of salt consumption, per ton of bleaching powder, represented by the condensation, I venture to express the opinion that these furnaces have been superseded. Being open furnaces, the principle is wrong, the hydrochloric acid being highly heated and diluted with the products of combustion and excess air, and consequently is in that condition in which it is impossible to obtain satisfactory condensation. Heat and dilution constitute the difficulties in condensing hydrochloric acid, and of the two, dilution is the more prejudicial. The Jones furnace and the Mactear furnace have been superseded by the plus-pressure hand furnaces, which have proved so satisfactory that they have been largely adopted by alkali manufacturers. Being close and not open furnaces, the hydrochloric acid is evolved at a very low temperature, and not mixed with the products of combustion, which go direct to the chimney. The only dilution of the hydrochloric acid arises from the small amount of air that enters the doors of the roaster, when the men are working and drawing their batches. Instead, therefore, of the hydrochloric acid being evolved highly heated and diluted, as in the Jones and Mactear furnaces, it is in the plus-pressure furnaces produced at a comparatively low temperature, and being only slightly diluted, is easily condensed into acid of high density for the stills. Comparing the Black and Larkin furnace, which I have carefully examined several times, and the plus-pressure hand furnace, it will be seen, as specially pointed out by Mr. Rennoldson, that the sulphate is roasted with closed doors, air being only admitted for a short time when the batches are being drawn, and consequently there is less dilution of the hydrochloric acid in the Black and Larkin than in the plus-pressure hand furnace. Then, the Black and Larkin furnace is also worked with a plus pressure, got by the very simple means explained by Mr. Rennoldson. Excellent, therefore, as the condensation is in the plus-pressure hand furnace, it must be better in the Black and Larkin, in which also there is complete removal of the low-level gas, and the obvious advantages of mechanically worked sulphate as against hand labour. Compared with the plus-pressure hand furnace, I do not think there is any saving on plant or fuel. Wages amount to 2s. in the Black and Larkin against about 2s. 10d. in the plus-pressure hand furnace, but this will be partly at least covered by the extra repairs on the machinery. Mr. Rennoldson states that the consumption of O. V. with the Black and Larkin furnace is only 78% on salt, and although this is a very low figure, I am inclined to think that it must be rather less than in the plus-pressure hand furnaces. I think it would be difficult to show a direct financial saving in favour of the Black and Larkin over the plus-pressure hand furnace, which is really a very satisfactory one, but the well-recognised advantage of a really efficient machine over hand labour, the complete removal of the low-level nuisance, better condensation, combined with the durability of furnaces, which I have quite satisfied myself about, constitute the advantages which the Black and Larkin possesses over the plus-pressure hand furnaces, and which justify me in expressing the opinion that it is the furnace by which bleaching powder can be made from the least consumption of salt, and also that it is the furnace, taken as a whole, which best suits the requirements of the present day.

ON SECURITY OF DOCUMENTS.

BY J. JAMESON.

This paper described the importance of mordant in writing ink, and the dangers which would arise from the use of ink containing no mordant, such as a mixture of lamp black and gum water, and it then described means of protection against the use of such ink. It referred to dangers arising from the use of a film on postage stamps soluble in water, but impervious to obliterating ink, which rendered the present system of obliteration inefficient, and finally dealt with a new application of soluble films on paper for transformation advertisements, Christmas and birthday cards, etc., the arrangement being such as that washing with water removes all printed matter, which is carried on the filmed surface, leaving any printing below it intact. Some very striking examples of transformation were shown, and samples were handed to the members. The protected paper and transformation pictures are shown at the Inventions Exhibition, the latter as Reid's patented system.

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Notices of papers and communications for the Meetings to be sent to the Local Secretary.

Meeting in the Rooms, 207, Bath Street, on Tuesday, May 5.

MR. G. BEILBY IN THE CHAIR.

WOOD NAPHTHA.

BY MR. C. A. FAWSITT.

As the distillation of wood and the working up of the resulting products form an important branch of the chemical industry in the West of Scotland, I thought it perhaps might be of interest to some of the members of this Society, if I read a short paper on what, in this district, is termed "wood naphtha," but elsewhere generally "wood spirit."

In the first place I shall say a few words on the composition of wood. Secondly, give some conditions on which the yield of the different products of wood distillation depends. Thirdly, dwell more particularly on the preparation, properties and uses of wood naphtha.

1st. As to the composition of wood.

Wood consists principally of cellulose, impregnated with incrusting material, such as resin, volatile oils, sugar, gum, tannin and protein bodies, besides the usual mineral constituents of plants.

The amount of incrusting material varies, being more abundant in hard and heavy varieties than in light and soft kinds; and wood which contains it in the largest proportion gives the most acid and naphtha on distillation. These incrusting materials contain more carbon than cellulose, and the greater the amount of carbon and hydrogen in wood compared with cellulose depends on a greater amount of these bodies. Beech wood was found, by Payen, to contain 40 per cent. cellulose and 60 per cent. incrusting material.

Wood is a highly hygroscopic substance, as is shown by the fact that if placed in air of ordinary temperatures, after having been dried completely at about 105° C., it takes up about 20 per cent. of water. Its average composition is as follows:—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen	Ash.	Water.
Dried at 120° C.	50%	6·0	42·0	1·0	1·0	—
Air-dried	39·2	4·7	34·5	0·8	0·8	20·0

2nd. Some conditions on which the yield of different products of wood distillation depends.

When ordinary air-dried hard wood is distilled in closed vessels, there results

Charcoal, which amounts to	21 to 26%	of weight of wood.
Liquid distillate ,,	50 to 55	,, ,,
Permanent gas ,,	20 to 25	,, ,,

You can readily understand that the weight of the different crude products depends on a variety of conditions.

The first I will mention are the species, age and condition of the wood, and also the soil it is grown in.

As regards the species, it may be said that hard woods are preferred by the wood distiller; and of these oak, beech and birch are most used in this district. The following example shows the difference in yield of acid for 100 parts oak and Scotch fir:—

	Crude Acid.	Acetic Acid.	Tar.	Charcoal.
Oak	47·6	5·4	6·4	24·9
Scotch Fir	45·0	2·7	10·0	28·0

You will notice that, although the weight of crude acid in both cases is much the same, the amount of acetic acid is very much less in the case of the Scotch fir; and I should like to mention here that the yield of acetic acid and naphtha always varies in the same direction—*i.e.*, if the yield of acid is large, so is that of the naphtha, and *vice versa*.

The condition of the wood when distilled has an important influence, sound wood giving much better results than unsound. It should also, previous to distillation, have lain for some time, in order that a considerable proportion of the water might escape. This is then called "air-dried" wood. It appears to lose water for about 1½ to 2 years after it is cut, and should not be used, at the soonest, within one year of the time of cutting.

New beech wood contains....................30 to 35% H_2O
,, ,, well air-dried, contains 16 to 20% H_2O
Trunk wood gives more acid than branch wood.

We will now notice another important set of conditions—namely, temperature, size and shape of retorts.

The temperature has a most important influence, and it can be taken as an invariable rule that a low heat gives more charcoal, acid, naphtha and tar, but less permanent gas, than a high one; and this can be readily understood if we remember that at a low heat bodies are formed, rich in oxygen, such as $C_2H_4O_2$ and CH_4O; but at high temperatures these same bodies are decomposed into compounds rich in carbon and hydrogen. For instance, acetic acid yields free carbon, benzene, naphthalene, acetone and permanent gas, whilst CH_4O gives permanent gas, containing acetylene and other bodies.

The size of the retorts, likewise, has a slight effect on the yield of the products. This is more marked near the end of the distillation, when the heat of the retort is, as a rule, at its maximum; and the gas travels slowly, both through the heated mass and along the heated walls of the retort.

The aim of the wood distiller is to obtain the largest possible yield of acid; and he, therefore, regulates the heat of his retorts accordingly. Experience has proved that the most suitable temperature is 350° to 400° C.

As soon as the temperature exceeds 400° C., the per cent. of acetic acid decreases; and as acetic yields acetone on being passed through a red-hot tube, one would imagine that the per cent. of acetone would increase; but it is not the case. I made two trials, conducted under exactly the same conditions, with the exception that in one case the temperature was 300° to 350° C., and in the other low red-heat. The crude acid, from experiment at the low temperature, gave ·42 per cent. of acetone, and at the high temperature ·39 per cent. The yield of both acid and naphtha were, in these experiments, one-third less in the case of strong heat.

It is impossible to formulate the reactions which take place inside the retort, as you cannot establish a fixed set of conditions as regards temperature, etc. Certain compounds are no sooner formed, we will say in the centre of the retort, than they pass into a more strongly heated space, and are at once dissociated.

I have seen it stated that a sharp strong heat gives a better yield of naphtha, but my experience does not bear out this statement.

I now come, 3rdly, to speak of the preparation, properties and uses of wood naphtha.

We will assume that the wood has been distilled, and that we have the liquid distillate, containing acid, naphtha and tar, to work up for the naphtha. It is allowed to stand for some time, when the tar falls almost completely to the bottom of the vessel, and the crude acid forms a watery layer on the surface. This latter, amounting to 42 to 47 per cent. by weight of wood distilled, is drawn off and worked up for the acid and naphtha it contains, according as to what acid products are required. In this district these are,

for the most part, acetate of lime, iron liquor, and brown sugar of lead.

If acetate of lime is wanted, the crude acid gets in most cases a plain distillation, to rid it of most of the tarry matters. The distillate is then neutralised with lime, allowed to settle, and the supernatant liquor distilled. The naphtha being the most volatile, comes over at the commencement, and should be collected until the runnings have a sp. gr. ·995 to 1·000. A very common test in use at many works is for the still-man to throw a small quantity of the runnings upon some hot cinders, and if the gases evolved do not take fire, he concludes it is time to put off the still. It is needless for me to dwell on the unreliability of such a test, and in these days, when we hear so much about the great strides which are being made in methods of testing in chemical works, it should be replaced by a better one.

If sugar of lead or iron liquor are wanted, the crude acid is distilled, and the naphtha collected, until the runnings show same strength as in the previous case. Care is required to keep the acid from coming over. I have often worked crude naphtha, which would have paid much better to work for the acid than for the naphtha it contained; but I find dull times are the best remedy for such carelessness.

The crude naphtha, by either process, has an average sp. gr. 0·980, and varies from 0·970 to 0·990. It has a dark-brown colour and strong smell, and must, from what has previously been said, be a complex liquid.

Besides water, crude wood naphtha contains the following compounds :—

	Formula.	Boiling. Point.	Sp. Gr.
Methyl Alcohol	CH_3OH	.... 65·0....	0·79589 at 15·56° C.
Acetone	$(CH_3)_2CO$	.... 56·3....	0·8144 at 0° C.
Methylic Acetate ..	$C_2H_3O_2CH_3$	.. 56·3....	0·90085 at 21° C.
Aldehyde	C_2H_4O	.. 20 8....	0·8009 at 0° C.
Allyl Alcohol	C_3H_5OH	.. 103	0·8706 at 0° C.
Di-methyl Acetate ..	$C_2H_4\left\{\begin{matrix}OCH_3\\OCH_3\end{matrix}\right\}$	..63-64 ..	0·8787 at 6° C.

Also small quantities mono-, di-, tri-, methylamine, acetate of ammonia, oils and tarry matters.

The wood naphtha from manufacture of sugar of lead and iron liquor almost always contains free acetic acid.

There are several methods in use for working up the crude naphtha; but the one which finds most favour in this district, and which gives a very good finished product at a small cost for plant and material, is to distil with lime, which retains the water and acid, decomposes almost entirely the methylic acetate, simple and compound ammonias, acts upon the oils in such a manner as to convert the greater part of them into solid resinous bodies of high boiling points, and has also the effect of diminishing the percentage of acetone, which, on treatment with lime, gives condensation products of high boiling points. It is important to decompose the methylic acetate, as on account of its high sp. gr. it, if present in large quantities, makes it difficult to work the naphtha down to the usual strength, 61 O.P., sp. gr. ·827.

A source of considerable trouble to the rectifier of wood naphtha is the oils contained in the crude, and although they, for the most part, boil considerably over 100° C., on account of the large quantity of steam given off, are, in the distillation, easily carried over along with the naphtha. They are very soluble in strong naphtha, but can be separated again by merely diluting with water, when they usually rise as an oily layer to the surface of the liquid; in some cases they sink to the bottom of the vessel.

It is essential to remove these oils as completely as possible, as a small percentage is injurious, as I shall show farther on.

As to the composition of these oils very little is known. According to Cahours they contain, besides other bodies, toluene, xylene, and cymene; Kramer and Grodski found subsequently that they contain ketones, which, on treatment with $ZnCl_2$ and H_2So_4, give toluene, xylene and cymene.

I made a fractional distillation of a sample, and below you have the results :—

300cc. taken, sp.gr. ·876 at 15·5° C.
A : Thermometer in liquid.
B : ,, ,, vapour.
Began run : A, 80° C.
,, ,, B, 65° C.

	A.	B.
5%	90° C.	70° C.
10	110	84
20	133	120
30	140	130
40	146	136
50	152	142
60	160	151
70	168	158
80	178	168
90	193	183
95	203	191

Specific Gravity of the Distillate.

1st.—50cc.	0·840	at 15·5° C.
2nd.—50cc.	0·857	,, ,,
3rd.—50cc.	0·872	,, ,,
4th.—50cc.	0·881	,, ,,
5th.—50cc.	0·887	,, ,,
Last.—25cc.	0·901	,, ,,

You will no doubt notice that in the case of B., a considerable proportion of the oil comes over 130-142. Within these temperatures the three isomeric xylenes boil. This fraction is almost completely absorbed when shaken with 1½ times its volume of strongest sulphuric acid, which would be the case with meta- and ortho-xylene, as they are converted into sulphonic acids, but not if it consisted of paraffins or para-xylene. I do not say that this property of the oil proves the presence of the above-mentioned hydrocarbons, but it tends in the right direction. The finished wood naphtha, as it comes into commerce, is an almost colourless liquid, having a sp. gr. of 0·827 at 15·5° C. This sp. gr. corresponds to 61 O.P. by Sykes.

One of the principal uses of wood naphtha is in the manufacture of methylated spirit, but there are certain conditions which must be fulfilled before the Government will allow of its being used for this purpose, one of which is that it must have a pungent smell, so that it can impart the same to the spirits of wine, and so destroy its "magic" influence—*i.e.*, render it unfit for drinking purposes.

The following is the clause in the Excise regulations which treats of the strength and proportion of wood naptha to be added to the spirits of wine for manufacture of methylated spirit :—

"The spirit is not to be less than 50 O.P., nor less in quantity than 450 gals. at a time, and the proportion of naphtha or methylic alcohol, not less than one-ninth of the spirit. Strength of naphtha to be at least 60 O.P."

The buyer always specifies that the naphtha shall be "miscible,"—*i.e.*, it shall not produce turbidity when diluted with water. This turbidity arises from the presence of the oils above referred to, and which, on addition of water, are thrown down in a finely divided state, and give the solution a milky appearance.

The method adopted in this district, and also by a large number of firms in England, for taking the strength of the finished naphtha, is simply determinative of its sp. gr. The instrument used is that of Sykes, the readings of which are tabulated with corresponding strengths. These tables were made up for spirits of wine, and are still used in all the

Government offices for that purpose, but it certainly seems a little strange that the strength of wood naphtha, consisting chiefly of methyl alcohol, should be fixed by them. It so happens that the sp. gr. of methyl and ethyl alcohols do not, for the same percentage, differ very much; but, as it is becoming more the custom to buy by sp. gr., corresponding to a certain percentage, it would be decidedly preferable to adopt a table made up for methyl alcohol. The Sykes table gives the highest strength at 60° F. to be 67 O.P., which corresponds to sp. gr. ·815, but this only corresponds to 93 per cent. of CH_4O, as determined by Prof. Dittmar and myself, and you can see that by still adhering to the old tables confusion may often occur. A good average sample of finished naphtha, sp. gr. ·829, at 15·5, contains—

CH_4O	= 80%
Acetone	= 6
H_2O	= 12

Besides traces of methylic acetate, di-methyl acetol, methylamine and other impurities, should boil as under:—

100cc. taken.
A: Thermometer in liquid.
B: " " vapour.
Began to run: A, 67° C.
" " B, 64° C.

	A.	B.
5%	67° C.	66·5 C.
10	67·5	67
20	67·5	67
30	68·0	67·5
40	68·5	68.0
50	69 0	68·5
60	70·0	69·0
70	70·5	69 5
80	72 0	71·0
90	76·0	75·0
95	84·0	79·0

Not very many years ago wood naphtha was scarcely a saleable article. Its principal uses were for varnish and finish manufacture, and as a substitute for methylated spirit; but with the discovery of the aniline colours, and the large increase in the consumption of methylated spirit, the demand for this article has increased, and to-day, instead of wood naphtha being cheaper than methylated spirit, it is the reverse, the former varying from 4s. to 5s. per gallon, and the latter from 2s. 6d. to 3s. per gallon.

The principal uses for finished wood naphtha are for methylated spirit, aniline colour and varnish manufacture, the portion rich in acetone being chosen for the latter purpose, as it is a capital solvent for gums.

The quantity used for aniline colour manufacture is very small in this country compared with Germany, but the quality required for that purpose is much higher than that employed in making methylated spirit. It is to be hoped that organic chemistry will be more taught and studied in England and Scotland, so that the manufacture of articles of commerce, such as aniline colours, will be thoroughly understood and appreciated both by young chemists and manufacturers.

DISCUSSION.

Mr. Beilby paid a tribute to the author for his valuable contribution. He felt that it was the duty of each particular Section to bring into discussion the industries of the locality; and testified to the great want hitherto felt of technical literature bearing upon these industries, a want which such papers were intended to supply. He would like to ask the author whether stove-drying of the wood had been found to have any beneficial effect upon the yield of products? He also wished to know what method was used to determine the percentage of methyl alcohol present in purified-wood spirit.

Mr. Fawsitt, in reply, said that stove-drying had not proved beneficial as regards increase in the yield of products. They always used the methyl-iodide test for methyl alcohol in purified-wood spirit.

In reply to questions asked by Mr. Pattison, he said that naphtha was made miscible in water by extracting the oily portions by distillation, and that its so-called solvent action upon gums and resins was due to the acetone present.

Meeting held April 7.

MR. E. C. C. STANFORD IN THE CHAIR.

A NEW SYSTEM OF COOLING OILS FOR THE EXTRACTION OF PARAFFIN.

BY GEORGE BEILBY.

The separation of the solid from the liquid paraffins in their manufacture from crude shale oil or petroleum, is essentially a process of crystallisation and filtration. By fractional distillation of the partially purified oil a concentrated solution of solid paraffin in oil is obtained. In the manufacture as ordinarily practised in Scotland, this concentrated solution of paraffin, whose crystallising point is from 90° to 100° F., is exposed to the air in large trays or tanks, from one foot to two feet deep. In from two to four days, according to the season of the year, the oil is reduced to the temperature of the air or nearly so. The separation of paraffin by such slow crystallisation makes the solution into a perfectly solid mass, so thoroughly knit together by the interlacing of crystals, that the oil, which constitutes about 75 per cent. of the whole, cannot be separated by mere draining. In order that the oil and paraffin may be separated by filtration, it is necessary to crush the mass so as to destroy the general structure, leaving the individual crystals free. The crushed mass is pumped into filter presses, the oil passes through and the paraffin is retained in the cells. The paraffin obtained at this stage is known commercially as "hard scale," but a further crop of crystals of lower melting point is obtained from the first mother-liquor by concentrating it by distillation, and again cooling and filter-pressing. As this second crop of paraffin is of lower melting point, and is, therefore, more soluble in oil, it is the custom to cool the solution by means of artificial refrigerators, so as to crystallise and extract the paraffin at a temperature of 32° F., or as much below that point as possible. The apparatus most commonly used for this purpose consists of a drum or cylinder of cast-iron, kept at a low temperature by a current of cold brine led through it from a refrigerating machine. This drum revolves on a horizontal axis, its lower side dipping slightly in a tray containing the oil to be cooled. The cold surface of the drum, as it revolves, picks up a layer of oil from the tray, which layer, as it is carried round on the cold surface, is reduced to its temperature. After the layer has travelled round on the drum for about three-fourths of its revolution, it is scraped off by a steel knife which is pressed against the surface of the drum by springs and set screws. The cleaned surface in the course of its revolution again passes through the oil in the tray, taking up a fresh layer of solution to be cooled, solidified and scraped off. Thus the process is a rapid and continuous one, the warm oil is continually running into the tray, passing over the drum, and being scraped off and dropped into a suitable

receptacle, from which it is drawn by pumps and forced into filter presses. Various modifications of this form of paraffin cooler have been designed by Mr. A. C. Kirk, Mr. Southby, Mr. N. M. Henderson, and Mr. William Baxter, in every case the object being the rapid cooling of a large quantity of oil. Owing to the very low conducting power of paraffin for heat, quick cooling can only be obtained by bringing the oil in thin layers in contact with cold metallic surfaces; this principle was recognised and acted on in all of the coolers enumerated. Looked at simply as appliances for cooling, the maximum quantity of oil through the maximum number of degrees in the shortest possible time, these coolers are all really efficient. It is only when the desired object is, not merely the cooling of a solution of paraffin to a given temperature, but the efficient separation of the paraffin by crystallisation, that the principle of rapid cooling in thin layers is seen to be unsound.

The crystallisation of paraffin from solution in oil is in many respects analogous to the crystallisation of salts from aqueous solution. The size of the resulting crystals in both cases is very largely determined by the rate of cooling and deposition. A hot saturated solution of sulphate of sodium suddenly cooled to the atmospheric temperature deposits the salt in a granular or powdery form, whereas slow regular cooling produces large well-defined crystals. In solutions of paraffin in oil these effects of cooling are particularly well marked. When a hot saturated solution is suddenly cooled, the paraffin is deposited in an amorphous or only faintly crystalline condition, and is consequently very difficult to separate from the oil. On the other hand, if the solution is kept in repose, and under such conditions that the cooling is slow and regular, the paraffin deposits in large well-defined crystals, which are easily separated from the oil. These effects are most apparent in oils of high viscosity, and for two reasons: (1.) The viscous oil on being cooled to a low temperature itself becomes gelatinous or semi-solid, and in this state tends to retain the paraffin in an imperfectly crystalline state. (2.) The methods of refining which are necessary for the production of the most viscous oils, also tend to produce viscous or amorphous paraffin. Vaseline when properly prepared shows no trace of crystalline structure, and is, therefore, an excellent example of an amorphous paraffin mixed with a viscous oil. As the whole tendency of paraffin and petroleum refiners is to produce lubricating oils of maximum viscosity, the difficulty of separating the paraffin tends also to increase. In certain cases the viscosity practically

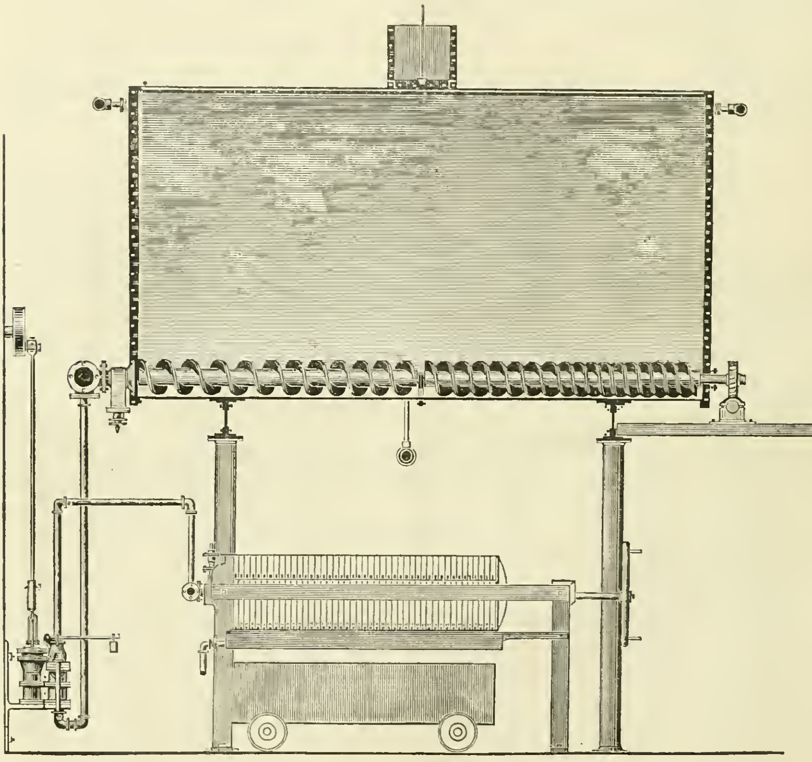


Fig. 1.

attainable is determined solely by the possibility of properly extracting the paraffin.

The value of slow regular cooling for the extraction of the first crop of paraffin or "hard scale" has for long been fully recognised, so far at least as natural or atmospheric cooling is concerned; but whenever refrigerator cooling has been used, the principle has been abandoned. Mr. A. C. Kirk tells me that at Mr. Young's Bathgate Works various schemes were proposed, and even partially worked out, for the cooling of paraffin oils in a state of repose, but these were put aside in favour of the more rapid system of cooling by drums.

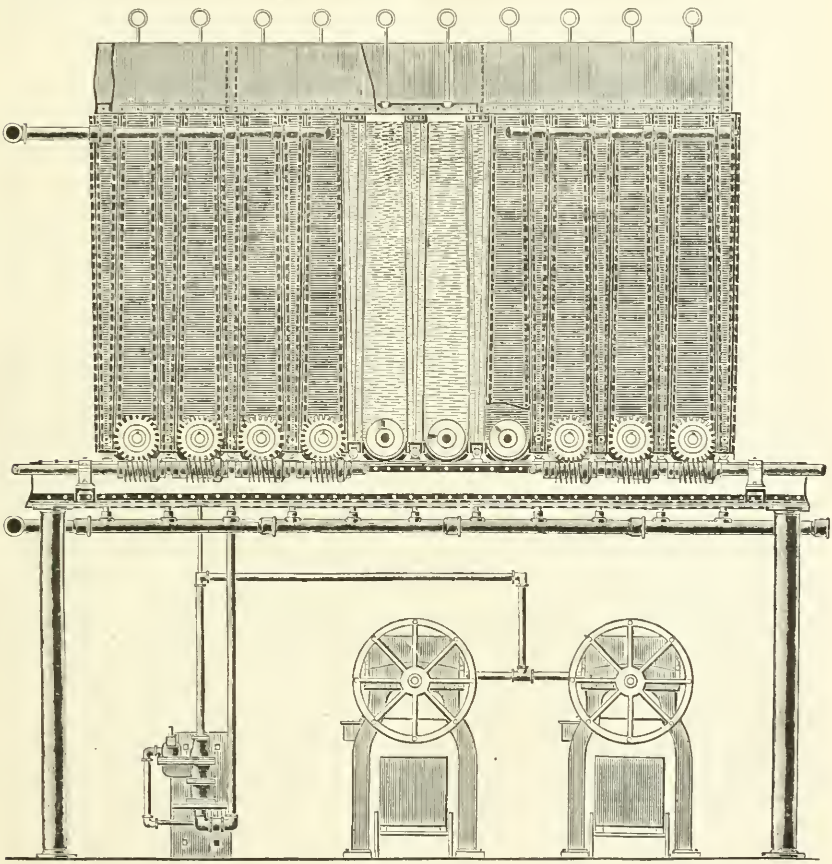


Fig. 2.

At Oakbank, about two years ago, it became necessary to devise means for cooling and crystallising certain very viscous oils. An experience of many years with this class of oils made it evident that proper crystallisation could only be ensured by cooling the oil slowly, and in considerable mass, to the desired temperature. The success of Mr. Coleman and others in maintaining a winter temperature in the meat safes of ships in the Tropics by means of refrigerating machines, made it seem not unreasonable to consider the possibility of cooling paraffin oils in an artificial winter atmosphere. When ways and means came to be considered, it was evident that the employment of tray coolers, one to two feet deep, was quite out of the question, on account of the enormous ground area that would be occupied for a given quantity of oil, involving the erection and cooling of very large buildings. The quantity of oil to be cooled at Oakbank was 8000 gallons per day, and assuming that four days were necessary for cooling it, accommodation for four days' oil or 32,000 gallons would have to be provided. This quantity of oil spread out in tanks one foot deep would cover a ground area of 5120 square feet, equal to a rectangle of 160 feet by 32 feet.

In the plans adopted and carried out at Oakbank, the coolers are turned edgewise, and are built in blocks with interspaces between the cells. It has been pointed out that the cooled and crystallised mass needs to be mashed or crushed before it can be filtered. In the flat tray coolers this has generally been done by manual labour, hand tools being forced through the

mass. In the coolers of this new arrangement such treatment was out of the question; it was, therefore, necessary to provide mechanical appliances for crushing the mass, and delivering it ready for the filter presses. After experimenting with various forms of crusher, the arrangement finally adopted was a screw laid along the bottom of each cell. The shaft of this screw passes out through a stuffing gland on the end of the cooler, and is fitted with worm gearing, by which it can be rotated when desired. The thread of the screw is right-handed, so that by rotating it backwards, or from right to left, the block or slab of cooled paraffin is bored out, the "borings" or crushed

In designing this plant it was necessary to know exactly the time that must be allowed for the effective cooling and crystallisation in cell coolers of a given size and thickness. Experiments were made in a temporarily fitted-up cold air chamber. A cooling cell one foot thick was filled with paraffin solution, at 95° F., and was subjected in this cold air chamber to a mean temperature of 21° F. for 96 hours. In the cooling cell were placed thermometers 1½ inches, 3 inches, and 6 inches from the outside. The temperature indicated by these, and by another thermometer hanging in the chamber, were observed and recorded every two hours. The results of these

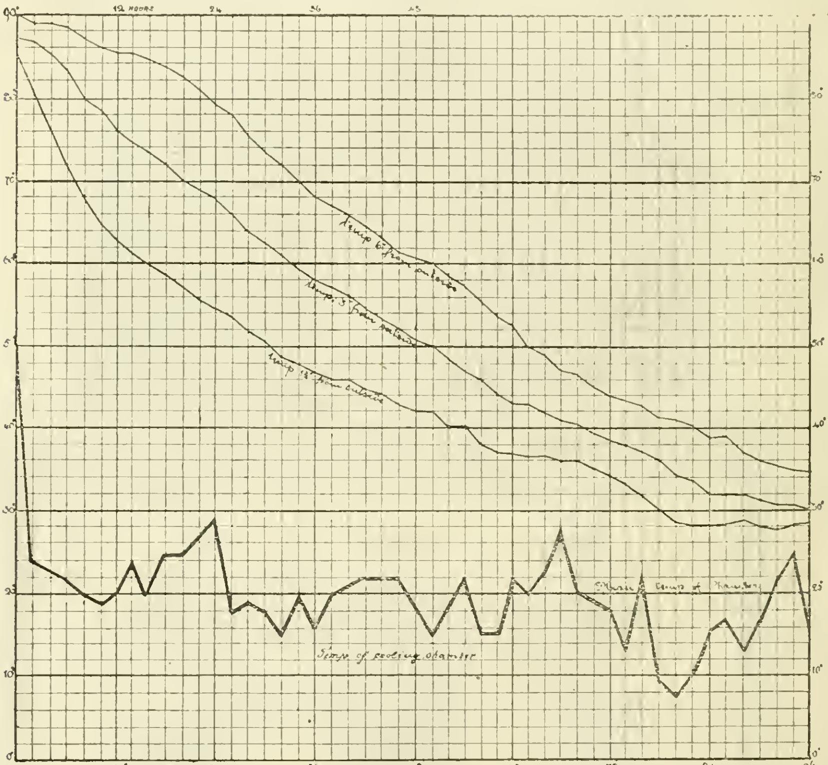


FIG. 3.

paraffin being delivered through an opening at the opposite end from the driving shaft. As the screw occupies the whole length and breadth of the cell at the bottom, the whole base of the block of paraffin is sheared away by its rotation, and as the cooling cells are wedge-shaped—wider at the bottom than the top—the whole weight of the block rests on its base. As the base is sheared away the whole block settles down, and is gradually sheared and delivered by the screw.

The drawings (Figs. 1 and 2) show a block of cells in longitudinal and cross section. The interspaces between the oil cells are enclosed and provided with pipes for the circulation of cold brine.

observations were laid down on a diagram (Fig. 3). The great irregularity of the temperature of the chamber was due to the imperfect character of the cooling engine, and to the small size of the chamber, but fortunately the low conducting power of the oil and paraffin saves the mass from any great irregularity in cooling. The conclusions from these experiments were: That with a suitable cooling medium, oil and paraffin could be cooled sufficiently in 96 hours in cooling cells one foot in thickness; further, that with this rate of cooling the crystallisation of the paraffin was thoroughly satisfactory.

To aid in determining the needful dimensions and strength of the screw, gearing, etc., determinations

were made of the crushing and shearing strength of the cooled block of paraffin at 32° F. These of course must vary with the percentage of paraffin and the viscosity of the solvent oil; it is, therefore, hardly worth while to reproduce them here. With the particular oil experimented with, it requires a pressure of three tons exerted on the pitch line of a 12-inch worm wheel to start the screw in the midst of the mass of cooled paraffin. The screw revolving at ·6 revolutions per minute throws 600 to 800 gallons of mashed paraffin per hour.

The cooling cells are arranged in four blocks of ten cells each. Each block contains one day's oil, or 8000 gallons. The blocks are carried on girders 10 feet above the floor level, the necessary filter presses being arranged on the floor below.

The house in which the cells are placed is built with double walls and a double roof, the interspaces being filled with non-conducting material.

Cold brine from an ammonia refrigerator is led through between the oil cells. A cold surface of about 1000 square feet is exposed to the air of the house, so that a considerable part of the effect of the refrigerator is devoted to keeping the air of the house cool. From experimental determinations of the conducting power of brick, it is estimated that the heat passing into the house through floor, walls, and roof, will amount during the heat of summer to the equivalent of six tons of ice melted per day.

DISCUSSION.

Mr. Coleman quite endorsed the author's views in respect of the advantages of slow cooling, compared with the old method of cooling rapidly by a revolving drum as detailed in the paper. He thought that the plan invented by Mr. Beilby of cooling in cells, and breaking up the mass by screw motion from below, was as ingenious as it seemed effective, and far less calculated to destroy the large crystals of paraffin. He stated that the reason why cold-air machines were used so extensively for meat preserving was that chemicals could not be employed for the purpose for hygienic and other reasons. But in the case of paraffin these objections were non-existent, and it then became a mere question of convenience and economy what method of refrigeration should be adopted. In conclusion, he considered that a debt of gratitude was due to the author for his very practical paper, and looked forward with interest to the results likely to accrue to the paraffin oil industry from the adoption of Mr. Beilby's process.

ON DESTRUCTIVE DISTILLATION.

BY PROFESSOR MILLS, F.R.S.

In the present paper I propose to deal with three topics—viz. (1) The definite character, (2) The limiting temperature, and (3) The course, of destructive distillation.

(1).—Definite Character of Destructive Distillation.—It is universally recognised that when such bodies as calcic hydrate or carbonate, hydric salicylate or potassic acetate, are destructively distilled, the results are of a very definite nature, and it is the custom to express these by exact symbolic equalities. The destructive distillation, on the other hand, of coal, shale, bone, wool, cellulose and the like, has always been vaguely regarded; as if it were of an indefinite character, and open to a vast variety of modification at the hands of the chemical inventor. It appears to me that all kinds of destructive distillation are equally definite when the evidence with regard to them is equally complete; and that they cannot be susceptible of indefinite variation, because the law of multiple proportions must apply, without exception, to every one of them. Some illustrations of this principle may be of interest to the section.

(*a*) *Coal.*—Most authorities are agreed that coal has been derived from more or less impure woody fibre or cellulose, $nC_6H_{10}O_5$, under the influence of heat, pressure, and time. The effect of heat is at first to dehydrate cellulose. By interpolation among Violette's well-known results on the heating of wood (*Ann. Ch. Phys.* [3], xxxii. 304), I find that $nC_6H_8O_4$ corresponds to a temperature of about 185°, and $nC_6H_6O_3$ to about 220°, in the absence of pressure; in presence of pressure, the latter temperature corresponds to $nC_6H_4O_2$. At a point somewhat below 430°, and without pressure, the residue has the composition, nC_6H_2O. The final stage nC_6 is probably not attained under ordinary experimental conditions.

According to these results, the composition and reactions of coal should turn upon the value of n, the losses of H_2O, and the collateral kinetic changes which, occurring in the course of these definite transactions, lead to the formation of isomeric (or even of polymeric) coals. The organic matter in coal or shale, if we agree to represent its composition by a formula, should correspond to an initial symbol nC_6 or $2nC_3$.

In constructing equations to represent the transformations of coal and other complex bodies I shall, for the sake of convenience, frequently employ collocations of symbols to indicate mean composition; it will be understood that these collocations are not intended to suggest separate chemical compounds.

Prof. W. Foster (*Proc. Inst. C.E.*, April, 1884) has completely analysed, and distilled at a high temperature, two samples of Yorkshire and one of Durham coal. His mean results, apart from sulphur, nitrogen, pit-water and ash, correspond to the following relations:—

$$2\,C_{24}H_{18}O = 33C + C_{15}H_{34}O + H_2O.$$

	Organic matter in coal.		Fixed carbon.		Gas and tar.		Organic water.
(Calc.)	100	......	61·5	......	35·7	......	2·8
(Found)	—	......	61·5	......	38·5 (35·7 + 2·8)		

Foster has also similarly examined a Scotch cannel. His data may in like manner be reduced as follows:—

$$2C_{12}H_{12}O = 12C + C_{12}H_{22}O + H_2O.$$

(Calc.)	—	....	41·9	......	52·9	......	5·2
(Found)	—	....	41·3	......	58·7 (52·9 + 5·2)		

In my work on Destructive Distillation (2nd Ed., p. 28) I have shown that the organic matter in a good average Scotch shale has almost exactly the composition $C_6H_{10}O$. According to additional data (*loc. cit.* p. 26), reduced as before, the changes which this undergoes at a low temperature may be represented by the equality,

$$7C_6H_{10}O = 18C + C_{24}H_{62}O_3 + 4H_2O$$

			Fixed carbon.		Gas and oil.		
(Calc.)	100	......	31·5	......	58·0	......	10·5
(Found)		......	31·2	......	58·3	......	10·5

At a high temperature, we have the relation

$$7C_6H_{10}O = 6C + C_{36}H_{62}O_3 + 4H_2O.$$

			Fixed carbon.		Gas and tar.		
(Calc.)	100	......	10·5	......	79·0	......	10·5
(Found)		......	12·8	......	76·0	......	11·2

The Heywood Cannel Gas Coal, which may be taken as representing an average Scotch cannel, has (*loc. cit.* and special communication to the author)

been analysed and distilled. The reactions are—at a low temperature—

$$4C_9H_{12}O = 27C + C_9H_{46}O_3 + H_2O.$$

		Fixed carbon.	Gas and tar.	
(Calc.)	100	59·6	37·1	3·3
(Found)		58·1	38·3	3·6

and at a high temperature—

$$4C_9H_{12}O = 24C + C_{12}H_{46}O_3 + H_2O$$

		Fixed carbon.	Gas and tar.	
(Calc.)	100	52·9	43·8	3·3
(Found)		52·5	43·9	3·6

The results for Boghead coal are as follows :—At a low temperature—

$$3C_{12}H_{20}O = 15C + C_{21}H_{58}O_2 + H_2O$$

		Fixed carbon.	Gas and oil.	
(Calc.)	100	33·3	63·3	3·3
(Found)		33·3	64·1	2·6

At a high temperature—

$$3C_{12}H_{20}O = 6C + C_{30}H_{58}O_2 + H_2O$$

		Fixed carbon.	Gas and tar.	
(Calc.)	100	13·3	83·3	3·3
(Found)		12·8	84·6	2·6

There is thus considerable evidence in favour of the definite character of the destructive distillation of coal and shale. It is probable that the organic matter in these minerals can be always represented with an nC_3 formula; and that a very simple relation exists between the C of the fixed carbon on the one hand, and the C of the [gas and tar (or oil)] on the other. It is clear also that C_3 is the fundamental unit, or stable condition, in these effects; and that not less than this unit must be removed from, or left in, the "fixed carbon" during destructive distillation. Hence it is hopeless to expect that, for instance, more than fractional variations in the yield of oil from a shale can be effected by modifications in modern retorting.

It would have been a great gratification to me if I could have rendered this part of my subject more complete, by splitting up the symbolic collocations for "gas and tar (oil)" into two others, for gas and tar (oil) respectively. Unfortunately no data at present exist for this purpose.

The following reductions may, however, serve as a guide and assistance in future investigations.

P. Frankland (*Journal* iii. 273) has given the composition of fifteen samples of purified coal-gas (presumably bituminous). The mean percentage and variations are as follows :—

Ethylene and its equivalents.	Hydrogen.	Carbonic Oxide.	Marsh Gas.
6·69	47·39	4·05	38·83
1·45	3·74	0·69	1·57
Variation.	Variation.	Variation.	Variation.

These ratios correspond to

$$3C_2H_4 : 24H_2 : 2CO : 20CH_4 : 2CO_2$$

(=102vols.; the last being added to fulfil the condition of unpurified gas). Summing the above formulæ, we have the collocation $C_{30}H_{140}O_6$, which may otherwise be expressed as $30CH_4 : 6H_2O : 4H_2$. Having regard to variation, we shall be correct in regarding average unpurified coal-gas as consisting of redistributed marsh-gas and water. Here also the C_3 unit recurs.

The same author (*loc. cit.*) gives the composition of three samples of gas from Scotch cannels. His figures tend to show that this gas tends to consist of redistributed methyl and water; but the data are too few, and their variation too great, to allow of any very exact inference.

The following complete analyses of London and average cannel gas-tar (Scotch) have been made in my laboratory :—

	London.	Scotch Cannel.
* Carbon	77·53	85·33
* Hydrogen	6·33	7·33
* Nitrogen	1·03	·85
Sulphur	·61	·43
Oxygen	14·50	6·06
	100·00	100·00

If we deduct nitrogen and sulphur, we shall obtain the following results :—

	London.	$C_{21}H_{22}O_3$.	Scotch.	$C_{18}H_{20}O$.
Carbon	78·82	78·26	86·44	85·71
Hydrogen	6·41	6·83	7·42	7·94
Oxygen	14·71	14·91	6·14	6·35
	100·00	100·00	100·00	100·00

The ubiquitous C_3 unit again appears in the mean composition of the tars; it must therefore be common to both kinds of gas.

(β) *Cellulose.*—The material used for this experiment was well scoured handkerchief cloth. It contained 5·99 per cent. of water, and yielded ·65 per cent. of ash. The still consisted of a glass flask holding 1130cc., whose neck sloped slightly downwards. By means of a piece of combustion tubing about 1·3m. long, this was connected with a two-necked receiver, on the outside of which cold water was constantly playing. The top of the still was covered with sheet asbestos. Heat was applied by means of a Fletcher burner. The distillation lasted six hours, during which a red heat was gradually attained. The following are the particulars of an experiment (substance taken, 100grm.) :—

	Grammes.
Water measured after drawing from receiver...	42·6
,, in substance	6·0
	36·5
Hydric acetate (sp. gr. 1·06) in water	2·4
	34·5
Acetate : water : : $C_2H_4O_2 : 2H_2O$	1·2
	35·7
Experimental drainage correction	1·1
Total water	36·8
=39·4 per cent. on dry organic cotton.	
Fixed carbon in retort	26·5
Ash correction	·7
	25·8

=27·6 per cent. on dry organic cotton.
Tar (heavier than water), about 2·5cc.
Hydric acetate, 2·040grm.
=2·20 per cent. on dry organic cotton.

The equation is

$$3C_6H_{10}O_5 = 12C + C_6H_8O_4 + 11H_2O.$$

	Fixed carbon.	Gas and tar.	Organic water.
(Calc.) 100...	29·6	29·6	40·8
(Found)......	27·6	30·0	39·4

In this case the weight of (gas and tar) is about equal to that of the fixed carbon. The C_2 from the acetate, added to the tar, amounts to about 3·6 per cent. Hence the gas, saturated with moisture, must have amounted to about 26·0 per cent. [In this and similar experiments, all the acid in the distillate is reckoned acetic.]

* Mean of two determinations.

(γ) *Jute.*—The sample contained 10·65 per cent. of water, and yielded 1·29 per cent. of ash. It was distilled in exactly the same way as the cellulose. The results, reduced as before, are in accordance with the relation :

$$C_{12}H_{18}O_9 = 7C + C_5H_8O_4 + 5H_2O.$$

	Fixed carbon.	Gas and tar.	Organic water.
(Calc.) 100...	27·5	43·1	29·4
(Found)......	27·5	41·3	31·2

The formula for jute is calculated from the analysis of Cross and Bevan (*Trans. Chem. Soc.* 1882, 100-101), who regard it as having the constitution of an aromatic cellulide. This may account for the unusual relations between the coefficients of C on the right-hand side of the equation. Jute furnishes 3·0 per cent. of acetate when distilled as above described. The amount of tar from 100 grammes exceeded 1cc. (a little having been lost). The gas, as before, may have been 38·8 per cent.

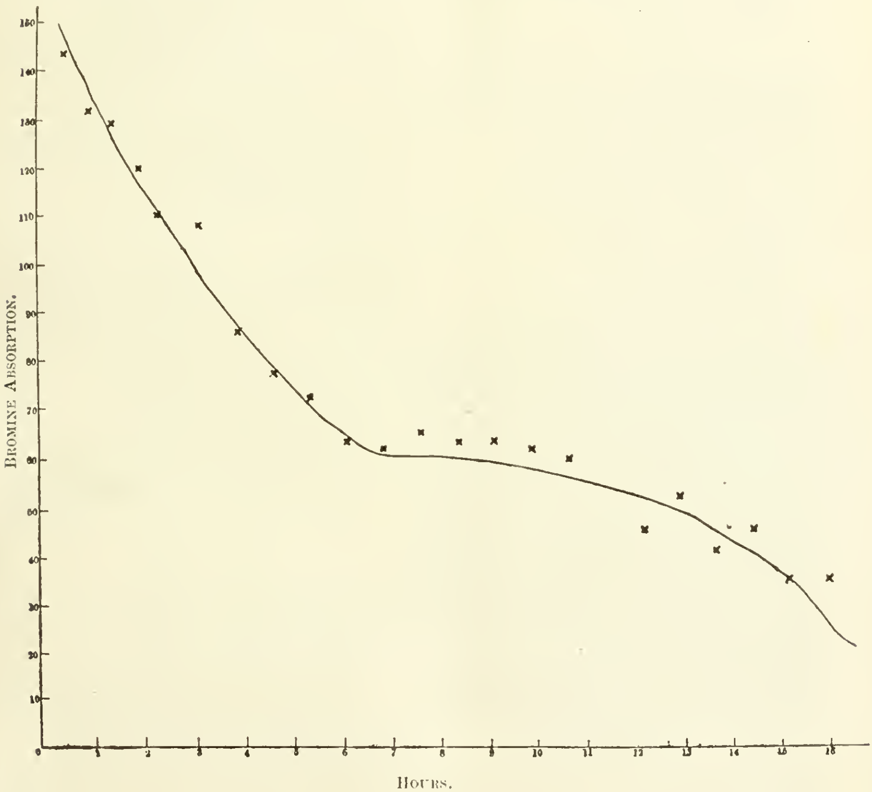
(δ) *Cannose.* — The sample contained ·15 per cent. of moisture, and yielded ·03 per cent. of ash. The same apparatus was used as before. The operation is extremely liable to fail, owing to intumescence. Accordingly, only 25 grammes were distilled, the time taken being eleven hours. The corrected results were as follows :—

$$C_{12}H_{22}O_{11} = 9C + C_3H_2O + 10H_2O.$$

	Fixed carbon.	Gas and tar.	Organic water.
(Calc.)	31·6	15·8	52·6
(Found)......	31·5	17·7	50·8

Sugar furnishes 2·42 per cent. of acetate when thus distilled, and very little tar. The gas probably amounted to about 17½ per cent. The C_3 unit now reappears.

(ε) *Wool.*—The sample, which consisted of well-scoured yarn, contained 14·93 per cent. of moisture, and yielded ·84 per cent. of ash. 50grm. of it were distilled during six hours in the same manner as before ; excepting that a suitable tower, containing standard acid, was placed to intercept any ammonia that might pass off with the gas. The first products observed in the course of the distillation were hydric sulphide and water ; crystals of ammonic carbonate were observed next ; and these were succeeded by a pale yellow oil. The distillate smelled very strongly



of members of the pyridine series; and a very pungent body, probably acridine, occurred in the latest stages of the operation.

Analyses of wool by Märcker and Schulze, and Scherer, are given in Watts's *Gmelin*, xvii. 351 [an unfortunate exchange of H for N in this analytical statement led me some time since (*Trans. Chem. Soc.* 1883, 142) to an erroneous formula for wool]. Their percentages agree fairly well with the expression adopted below.

	Marcker and Schulze. (Mean.)	Scherer.	$C_{39}H_{65}N_{11}SO_{13}$
Carbon	49·54	50·65	50·49
Hydrogen	7·29	7·03	7·01
Nitrogen	15·60	17·71	16·61
Sulphur	3·44		3·45
Oxygen	24·13		22·44
	100·00		100·00

The "fixed carbon" contained a considerable quantity of nitrogen. The following equation corresponds with the determinations so far as made:—

$$\underbrace{C_{39}H_{65}N_{11}SO_{13}}_{} = \underbrace{C_{21}N_3}_{\text{"Fixed carbon"}} + \underbrace{C_{10}H_{39}}_{\text{Gas and tar,}}$$

$$+ 5(NH_3CO_2) + 3HCN + H_2S + 3H_2O.$$

	Percentages found.	Calc.
Water	5·4	5·8
Residual carbon	24·9	26·1
Nitrogen therewith	4·3	4·5
Ammonia	8·6	9·2

It must, however, be added that the sulphur was not entirely evolved, as I found ·24 per cent. in the fixed nitrogenous carbon. Portions, also, of CO_2 and HCN ought doubtless to be credited to the gas and tar; but it would have been a matter of extreme difficulty to determine the free cyanide and carbonate. The actual tar amounted to about 2·5cc. per 50grm. of wool: it was lighter than water.

We have thus seen that as regards coal, cellulose, cannose and wool, the process of destructive distillation has certain stable stages; which, when expressed in the common chemical symbols, correspond to C_3 or a multiple of C_3. In the case of jute, also an apparently definite but partially aromatic compound, this relation either does not hold good or has become obscured. By adopting collocations of symbols to represent the average composition of the products of destructive distillation, we arrive at distinct and simple outlines of the complex results with which we had been previously familiar.

(2) Limiting Temperatures.—In a recent memoir [*Phil. Mag.* (5) xvii. 173] I have shown that the boiling points of all known normal paraffins having an even coefficient x of C are comprised in the equation

$$y = \frac{39·315(x-3·94)}{1 + ·070753(x-3·94)}$$

Similarly, when the coefficient of C is uneven, the equation is

$$y = \frac{38·992(x-3·92)}{1 + ·070564(x-3·92)}$$

When x is made exceedingly large in these equations, y (the boiling point) becomes 555·67 and 552·58 respectively. These values very nearly agree; and we may take their mean, 554°, as a working number. The normal paraffins have the highest boiling-points of any substances which it is the object of the shale-distilling industry to attain. Hence this number represents the highest temperatures required in the interior of a shale retort during the evolution of paraffins.

(3) The Course of Destructive Distillation.—The course of destructive distillation admits of quantitative admeasurement in various ways. The usual method is to determine gravities; but so far as I am aware, no chemical method is ever systematically followed at works.

The destructive distillation of resin furnishes an excellent illustration of the ineffectiveness of the physical, as compared with the chemical, examination. While the extreme range of gravities in the distillate is only from ·90968 to 1·03038, the range of bromine absorptions is from 32·02 to 142·48. A distinguished firm of Glasgow distillers very kindly placed at my disposal a series of samples representing a complete distillation from one of their smaller stills. The samples were carefully sealed, and allowed to rest in a warm place for about eight months, at the end of which time the separation of the water was regarded as practically at an end. Two bromine absorptions (by the titration method) were then made for each sample, and the gravities determined at 9° C.

The resin used for distillation was American. It was blackish brown in colour. Specific gravity at 15° C. = 1·065; bromine absorption (determined colorimetrically) 101·66 per cent. [Pure resin absorbs nearly 112·96 per cent.]

The following table contains the whole of the results:—

No. of Sample.	Hours.	Sp. Gr.	Bromine Absorption.	Remarks.
			per cent.	
1	0·5	·90968	142·48	Spirit begins
2	1·0	·92308	131·56	
3	1·5	·92890	128·70	
4	2·0	·92342	119·24	
5	2·5	·93863	109·62	
6	3·25	·95100	107·18	Spirit ends. Oil begins
7	4·0	·98400	85·31	Not quite clear. More viscous
8	4·75	·98429	77·27	
9	5·50	·99601	71·20	
10	6·25	·99792	63·37	
11	7·00	·99820	60·74	
12	7·75	·99621	63·50	
13	8·50	·99621	61·28	
14	9·25	·99621	61·62	Darker coloured
15	10·00	·99332	59·61	Still darker
16	10·75	·99241	57·28	" "
17	11·50	·99181	52·60	Less dark
18	12·25	·99920	43·46	Dark layer at surface. Less viscous
19	13·00	·99880	50·76	Darkest of all
20	13·75	1·03038	38·83	Dark and turbid
21	14·50	1·01731	41·89	" "
22	15·25	·99122	32·30	Very dark
23	16·00	·96960	32·02	Nearly as dark as 19

From these experiments some interesting inferences may be drawn. In the first place it is evident that neither the specific gravity nor bromine absorption follows a perfectly regular course; this is very possibly due to unavoidable errors in firing, and to some superheating at the sides of the still, which did not contain more than about 1000 gallons. On the whole, however, the bromine absorption quite evidently decreases as the specific gravity increases, and from sp. gr. ·90968 to 1·03038 (the extreme range) 1 per cent. of bromine corresponds to about ·00058563 sp. gr. There is some indication of a break in the series, where spirit ends and oil begins. The extremely heavy bodies formed towards the close of the distillation split up at last into lighter ones; but as shown by the bromine absorption, these are probably of nearly the same chemical order as the heavy ones. As the course of the distillation proceeds from a great to a small bromine absorption, it involves the formation of more and more saturated bodies; in other words, an approximation is continually in progress towards the composition of the paraffin series.

In the accompanying drawing (page 327), I have plotted out the relation of bromine absorptions to time. Through the experimental points have been drawn two curves, whose equations are:

$$y = 158{\cdot}5({\cdot}86406)^t \text{ and}$$
$$y = 62{\cdot}4 - 2{\cdot}2657(1{\cdot}3689)^{t-7}$$

t being the number of hours, and y the bromine absorption. It will be observed that the first curve is in fair agreement with the actual work, and indicates that the bromine absoption could not exceed 158·5 per cent. This curve terminates at about the seventh hour, after which the absorption alters very little until the tenth hour, when it decidedly begins to fall. The exact position of the second curve is much more difficult to find, and lies less close to the experimental points. This indeed might have been reasonably expected from the diminished content of the still, the increasing effect of the heat, and the consequent magnifying of every irregularity that occurred. Better results could doubtless be attained with a still of greater capacity.

I wish to express my great indebtedness to Mr. Muter, and in particular to Mr. C. Ellis, F.C.S., for their practical assistance in connection with this paper.

DISCUSSION.

Mr. Beilby, in proposing a vote of thanks to Professor Mills, said: It is unfortunate that Dr. Mills is not present to give us some further information as to the principles which have guided him to some of the deductions made in his paper. I am satisfied that the chemistry of destructive distillation can most profitably be studied if pure substances of known composition and constitution are operated on. Coal and shale are such complex substances, that even if their behaviour on distillation is carefully studied, the knowledge so gained can only contribute detached or partially connected facts, from which general laws cannot be deduced. I quite agree with Dr. Mills that the possible yield of paraffins from a given shale is quite definitely limited by the nature of the material, but are we further to understand him to say that these limits can be defined by a mathematical formula when nothing but the *ultimate composition* of the shale is known?

A NEW PROCESS FOR THE ESTIMATION OF SULPHUR IN PYRITES.

BY JOHN CLARK, PH.D., ETC.

As pyrites in this country is usually sold on analysis, the correct estimation of the sulphur which it contains is a matter of very great importance, both to buyer and seller. Chemists are practically unanimous in their opinion, that the best way of estimating the sulphur consists in oxidising it to sulphuric acid, and afterwards precipitating it as sulphate of barium. The oxidation of the sulphur can be effected either by a wet or dry process. The wet methods which consist in oxidising the sulphur with nitric acid, nitro-hydrochloric acid, or chlorate of potash and hydrochloric acid, require great attention to details to obtain even approximate results; but even when the greatest care is taken there are always two sources of error due, first, to the iron which is carried down by the sulphate of barium, and, secondly, to the solubility of the sulphate of barium in the acid perchloride of iron solution.

These errors, it is true, operate in different directions, but they do not counterbalance one another, the increase of weight due to iron being as a rule small, compared to the loss arising from the solubility of the sulphate of barium. The existence of these errors has been clearly proved by the experiments of Fresenius (*Zeitschrift*, xix. 53), and is admitted by Lunge (*Zeitschrift*, xix. 419); and it is to them that the difficulty of obtaining concordant results is frequently due. That considerable differences may be expected, is very well illustrated in the valuable paper of Fresenius to which I have just referred, and in which he points out that four assistants operating on the same sample, and strictly in accordance with the details laid down by Lunge in his work on sulphuric acid and alkali, found respectively:

$$\left.\begin{array}{l}42{\cdot}14\\42{\cdot}46\\42{\cdot}76\\43{\cdot}10\end{array}\right\}\text{ Per cent. of sulphur. }\left\{\begin{array}{l}\text{Mean}\\42{\cdot}61\end{array}\right.$$

or a difference of ·96 per cent. of sulphur between the highest and the lowest estimation. I do not think however that these results represent the capabilities of the wet method, in the hands of experienced analysts, as by a slight modification of Lunge's method very concordant results can be obtained, provided the operator uses always the same quantity of acid and works under the same conditions. By this means the error becomes less apparent, but it does not cease to exist. To avoid the sources of error to which I have referred, Lunge proposes to separate the iron by means of ammonia, before precipitating the sulphuric acid with chloride of barium; but I think it will be generally admitted that the elimination of the iron can be effected more conveniently by a dry fusion process.

For this purpose Fresenius recommends the fusion of the pyrites with ten parts of a mixture of carbonate of soda and nitrate of potash, extraction with water, precipitation of any lead with carbonic acid, evaporation with HCl to expel nitric acid, and precipitation with chloride of barium in presence of a small quantity of free acid. By this means the whole of the sulphur of the pyrites is obtained. The same sample of pyrites to which I have referred, when treated in this way gave in the hands of Fresenius' assistants:—

$$\left.\begin{array}{l}43{\cdot}82\\44{\cdot}04\\43{\cdot}74\end{array}\right\}\text{ Per cent. of sulphur }\left\{\begin{array}{l}\text{Mean}\\43{\cdot}87\end{array}\right.$$

or a difference of 1·26 per cent. between the means of the wet and the dry method.

The objections to this process are (1) The liability to loss by spurting from the violence of the action which takes place when the pyrites is fused with a mixture of carbonate of soda and nitrate of potash.

(2) The difficulty of operating upon more than half a gramme of the substance.

(3) The time occupied in evaporating to get rid of the nitric acid.

The new method of estimating the sulphur in pyrites, which I have to lay before you, avoids these objections, and at the same time secures the elimination of the iron.

C. Fahlberg and M. W. Iles discovered (*Ber. der Deut. Chem. Ges.* xi. 1187) that when sulphides are fused with caustic potash or caustic soda, the sulphur is completely converted into alkaline sulphite or a mixture of sulphite and sulphate, provided at least twenty-five parts of alkali are used for each part of sulphur, and they pointed out that under these conditions no sulphide or hyposulphite was produced.

In the course of my experiments, I found that when the alkali is intimately mixed with calcined magnesia, the sulphur under favourable conditions can be completely converted into sulphuric acid or alkaline sulphate with little more than the theoretical quantity of alkali, but it is always advisable to use a moderate excess. It is upon this action that the process for the estimation of sulphur in pyrites which I am about to describe is based.

Process.—The magnesia mixture which I employ is made by grinding together, in a porcelain mortar, pure sodium hydrate made direct from the metal, and pure freshly-calcined magnesia. The product is a light powder, which can be kept for any length of time in a properly stoppered bottle, without undergoing any appreciable change. A blank experiment must always be made with each lot of the mixture to test the purity of the materials, and any sulphur found is deducted.

In carrying out the process, from 1 to 1½grm. of the dry pyrites, in a fine state of division, is introduced into a platinum crucible with four times its weight of the pulverised magnesia and sodium hydrate, and the whole is intimately mixed in the crucible itself, by stirring with a glass rod. The crucible is then placed in the mouth of a muffle furnace, and exposed to a low red heat for about three-quarters of an hour. Oxidation begins at once, and is practically complete in less than half-an-hour. The contents of the crucible do not fuse but simply contract in volume, and leave a space between the sides of the crucible and the contents, and there is practically no action on the platinum. After heating for three-quarters of an hour, the crucible is allowed to cool, then placed in a vessel containing water. In a few minutes the contents fall to powder, and the crucible is washed out. A stream of carbonic acid gas is then passed into the solution containing the insoluble, for about a minute, to precipitate any lead which may be present and carbonate the remaining alkali. The contents of the vessel are then boiled for a short time, and the solution passed through a filter. The insoluble is boiled three successive times with water, and about half a gramme of pure carbonateof soda, then thrown upon the filter and well washed with boiling water. The filtrate, which will now contain the whole of the sulphur as sulphate of sodium, and be perfectly free from iron and magnesia, is first neutralised with HCl, then acidified with about 3cc. of HCl, heated to the boiling point, and the sulphuric acid precipitated with a slight excess of chloride of barium. The precipitate is allowed to stand for several hours, then filtered, washed, dried, ignited, and weighed. The sulphate of barium thus obtained is perfectly pure. It is always advisable to dissolve the residue on the filter in HCl, and test for sulphuric acid. If any precipitate makes its appearance after standing for several hours, it must be filtered off and added to the result; but with proper care, this will be found to be merely a precautionary operation. I have made a great many estimations of sulphur in different samples of pyrites by this process, and have invariably got results which agreed very closely with one another. I have found, however, that to get complete oxidation with the above proportions of soda and magnesia, it is necessary to use the muffle, or at least to heat the crucible in such a way that the products of combustion will not come in contact with the contents of the crucible. Apart from the danger of the result being vitiated by the sulphur in the gas, the process of oxidation is affected by the products of combustion, so that it requires a much larger proportion of the magnesia mixture to effect complete oxidation.

For the purpose of testing this process, and comparing the results with those obtained by experienced analysts by the ordinary wet method, Mr. Inglis, who is the head of the laboratory of the Tharsis Sulphur and Copper Company, very kindly furnished me with samples of pyrites, which had been carefully analysed under his supervision, and I may add that I was not aware of the results, by the wet method, till my tests were completed and in Mr. Inglis's hands.

The samples were marked A and B, and the following are the percentages of sulphur which were obtained by both processes :—

Clark's New Method. Sulphur per cent.	A.	B.	Tharsis's Wet Method. Sulphur per cent.	A.	B.
1 Exp.	50·18 ...	46·13	1 Exp.	49·46 ...	45·68
2 ,,	50·00 ...	46·17	2 ,,	49·58 ...	45·50
3 ,,	50·01 ...	46·16	3 ,,	49·58 ...	45·41
4 ,,	50·08 ...	46·18	4 ,,	49·62 ...	45·48
5 ,,	50·07 ...	46·16			
Mean	50·06	46·16	Mean	49·56	45·51

Another sample of pyrites which, in the hands of Mr. Tatlock, gave by the ordinary wet method 46·64 and 46·61 per cent. of sulphur, when analysed by my method yielded

47·24 per cent. of sulphur.
47·41 ,, ,,
47·20 ,, ,,
47·22 ,, ,,

or a mean of 47·26 per cent. of sulphur.

From these analyses, and a number of others which I could enumerate, if necessary, it would appear that the results obtained by this method are somewhat higher (about ½ per cent.) than by the wet method. This is what was to be expected when the sources of error to which I have referred are eliminated, and it corroborates the statements of Fresenius, although the difference is not so great as his experiments led me to expect.

The process which I have just described does not occupy more time than the ordinary wet method, and it avoids the sources of error—viz., nitrates, iron and excess of free acid—which so often lead to discrepancies.

DISCUSSION.

Mr. Tatlock testified to the importance of the subject brought before them by Dr. Clark. He felt that had the reading of the paper been the first intimation to him of the new process referred to, he would have felt sceptical of any advantages to be derived from it, especially in view of the concordant if indeed not absolutely correct, results of the wet process as shown by the table exhibited by the Tharsis Company. But having had an opportunity of examining the new process in detail, he felt convinced that it was destined to revolutionise the analysis of pyrites. At the same time he admitted the adoption of that process would inflict a certain hardship upon consumers, who, by a more complete estimation of sulphur in pyrites would have to

pay for more sulphur without obtaining any additional amount. At the same time he hardly thought that it would be sufficient ground for repudiation of contracts. Chemists, however, had nothing to do with these matters; their sole concern was to render methods of analysis as perfect as possible.

The CHAIRMAN, in concluding the discussion, thought that Dr. Clark had proved his case. There could be no doubt that the old process was open to objection on the grounds stated, slight though these grounds might be. He sympathised with Mr. Tatlock's early scepticism as to the process, but thought that it was practicable if only due care were taken to employ absolutely pure reagents.

Nottingham Section.

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S. E. Field.	R. L. Whiteley.
R. Fitzhugh.	

Hon. Local Secretary:
J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

The first meeting of the Section will take place on June 5th, when a Conversazione will be held at University College, Nottingham, on which occasion the Chairman will deliver his inaugural address.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

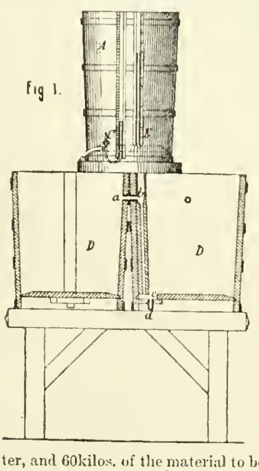
Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Lixiviation Apparatus. H. Parenty. Revue Industrielle, 1884, 353.

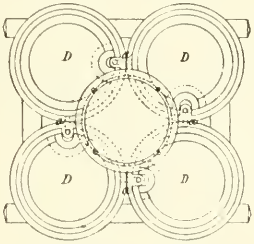
THIS apparatus, illustrated by Figs. 1 and 2, consists of four cylindrical vats, each capable of holding about 60

Fig 1.



itres of water, and 60kilos. of the material to be operated upon. The vats rest upon an oaken stand, and each is connected with the next one by means of a metal tube *a* leading into an upright tube *b*, open above and below. Each upright tube is provided with a valve below the metal connecting tube, in order to permit the connection between two adjacent vats being cut. A tube *d* at the bottom of each vat, and just beneath the upright tube, serves to empty the vat; a perforated plate at *c* acts as a strainer. A cistern A for water stands upon the four

Fig 2



circular vats. It is fitted with a gauge and tube, also a U-tube, with graduations, to measure the duration of the flow of water. In the bottom are four openings corresponding in position with the vats. The apparatus is mainly an adaptation of the Buff-Dunlop black-ash vat system to smaller and more exact operations, or even for laboratory use.—W. D. B.

Improvements in Filter-presses. J. H. Porter and J. Porter, London. Eng. Pat. 6808, April 25, 1884.

THE object of the patentees is to dispense with the filter cloths or strainers used in ordinary filter-presses. The plates are formed with a series of ribs upon their surfaces, which may be rectangular or angular. The projecting portions in one plate are opposite the spaces in the next plate, so that the passage of any liquid through the machine is diverted from one side to the other in a zig-zag fashion. The flow of liquid into the filter is continuous throughout its length, so that it passes over the whole surfaces of the plates in succession, inlets being formed alternately at the top and bottom of the chambers. The patentees state that the continuous friction of the surfaces of the plates as formed, causes the solid matter to be retained on such surfaces, the fluid being clarified thereby. Sand or charcoal may further be placed between the plates, so as to obtain further clarification. The claims are (1) the construction of filter-presses, in which the use of cloths is substituted by the friction of the surfaces formed as described; (2) filter-presses as described and shown.—C. C. H.

An Improved Filtering Apparatus. A. Domeier and B. Nickels, London. Eng. Pat. 7572, May 10, 1884.

THE improved apparatus is intended for use with liquids which contain a very small quantity of solid matter. It consists of a cylindrical tank, fitted with a cover and manhole at the upper part; the lower end is provided with a perforated bottom above a receiving outlet chamber, and a second manhole on a level therewith for the purpose of cleansing. The usual pressure gauge, inlet cocks, etc., are provided. The perforated plate is covered with cloth, over which is placed a second perforated plate; on the top of this is placed the filtering bed, consisting of any suitable substance, such as charcoal, sand, sawdust, lime, etc. The liquid is pumped into the cylinder, and then forced through by compressed air, the operation being repeated until the filtering bed is stopped, when it is removed through the lower manhole, a fresh bed formed, and the operation of filtering again started. The patentees claim under two heads the apparatus as described.—C. C. H.

Improvements in Filter-presses. H. H. Lake, London. From R. H. Smith, Carbondale, Pennsylvania, U.S.A. Eng. Pat. 13,580, October 14, 1884.

This patent is for an improved construction of plate used in filter-presses. A circular plate is built up of wrought-iron plates, a solid centre disc and two perforated discs, one on either side. The rim of the plate is formed of canvas or duck, several thicknesses being stitched together to form the recess for the deposition of the solid matter; this is secured to the plate by rivets. To strengthen the plate, pads or bosses are rivetted on its surface, of the same material and thickness as the rim; three or more of such pads are used, and bearing against each other when the plates are in the machine, they form a series of supports, thus preventing the plates from collapsing. The several details of construction are covered by seven distinct claims.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Calorimeter for Fuel. Fr. Schwackhöfer. Zeits. Anal. Chem. **23**, 453.

The author has constructed a calorimeter for determining the calorific power of coal or other fuel. The calorimeters usually employed are only adapted for small quantities of substance (a fraction of a grm.), and produce smoke, indicating thereby incomplete combustion. The author claims that in his apparatus these disadvantages are entirely avoided. The construction is given in the accompanying diagram.* A and A_1 are platinum combustion vessels, B a copper jacket, C the inner water vessel (the actual calorimeter) of nickled copper, D the inner non-conducting layer of eider-down, E a double-walled water vessel, F the exterior non-conducting layer of fine down, G a cylindrical wooden case, H the upper water vessel, J an annular cork board, K the lid, L the inner agitator, S and S_1 mirrors for observing the process of combustion, T_1 to T_{10} thermometers. The most important part of the apparatus is the combustion vessel. It is of platinum, and divided into two parts; the lower A is for the sample of coal, the upper A_1 for sugar charcoal. The chambers have openings at *a* and *b*, for introducing the fuel, and also for removing the sieves *c* and *d* after each experiment. The sieves are of platinum foil, perforated specially for the apparatus. The perforations of the lower sieve *c* are so small that they are only visible by transmitted light. In the upper sieve the holes are somewhat larger. Each is provided with an upright rim, which fits tightly to the side, and keeps it in its place. Three tubes are connected with the chamber A. *e* conducts oxygen from beneath the coal. The tube *f* has a double use: (1) to bring oxygen above the coal in order to ensure complete combustion of the evolved gases; (2) to observe the process of combustion by reflection from the mirror S_1. This is necessary, as the stream of oxygen requires to be carefully regulated, and the end of the combustion ascertained. The side tube *g* terminates under the sieve *d*. It is provided with a cross piece, and perforated on the upper side. It conducts oxygen to the upper chamber. All these tubes (*e*, *f*, *g*) are connected with well-fitting tubes, let into the lid of the case. After determining the actual thermal value of given volumes of water in the different vessels composing the calorimeter, it is next necessary to prepare and analyse quantitatively and calorimetrically the sugar charcoal to be used in the experiments. The calorimeter is then manipulated as follows: The vessel C is filled with 5200cc. of water at the temperature of the air, and 5·6grm. of the finely powdered sample of coal, and 2·4grm. of the charcoal weighed out. The quantities should be so chosen that the rise of temperature in C may be about 10° C. The combustion lasts about an hour. The coal is introduced into A, the charcoal into A_1, the two pieces then put together, and the jacket B screwed down, the lid is lowered, the thermometers inserted, and the mirrors mounted. When the apparatus indicates a constant temperature the combustion is commenced. Oxygen is led through *f*, the cap S raised, a small glowing chip thrown in, and the cap refitted. The charcoal in A_1 is kindled, and the aspirator O is put in action. The bottle N is then closed, and after some minutes the smaller aspirator is set going. The flow of water from O and P is regulated so that about five-sixths of the gases collect in O, and one-sixth in P. When the charcoal is almost burnt, sparks fall through the sieve and kindle the coal beneath. A quicker stream of oxygen is then passed through *f*, and introduced through *g*; towards the end of the experiment the oxygen through *g* is stopped, and *e* is opened. The combustion proceeds regularly, and not a trace of smoke appears in N. The combustion of both charcoal and coal should be complete. When the combustion is finished the aspirators are disconnected, the water is agitated by the mixer until the thermometers T_1 and T_2 stand at the same temperature, and the other thermometers are then read off. The volume of gas collected in the aspirators is noted, and the gas in P analysed. From these data the author has made a number of calorimetric determinations, which agree well together, and are somewhat higher than the value calculated by Dulong's formula from the percentage composition.—J. B. C.

* For full details the original paper should be consulted.

An Improved Method of and Apparatus for Extracting Ammonia from Furnace Gases. W. R. Lake, London. From the Société Anonyme Lorraine Industrielle de Hussigny. Eng. Pat. 5898, April 3, 1884.

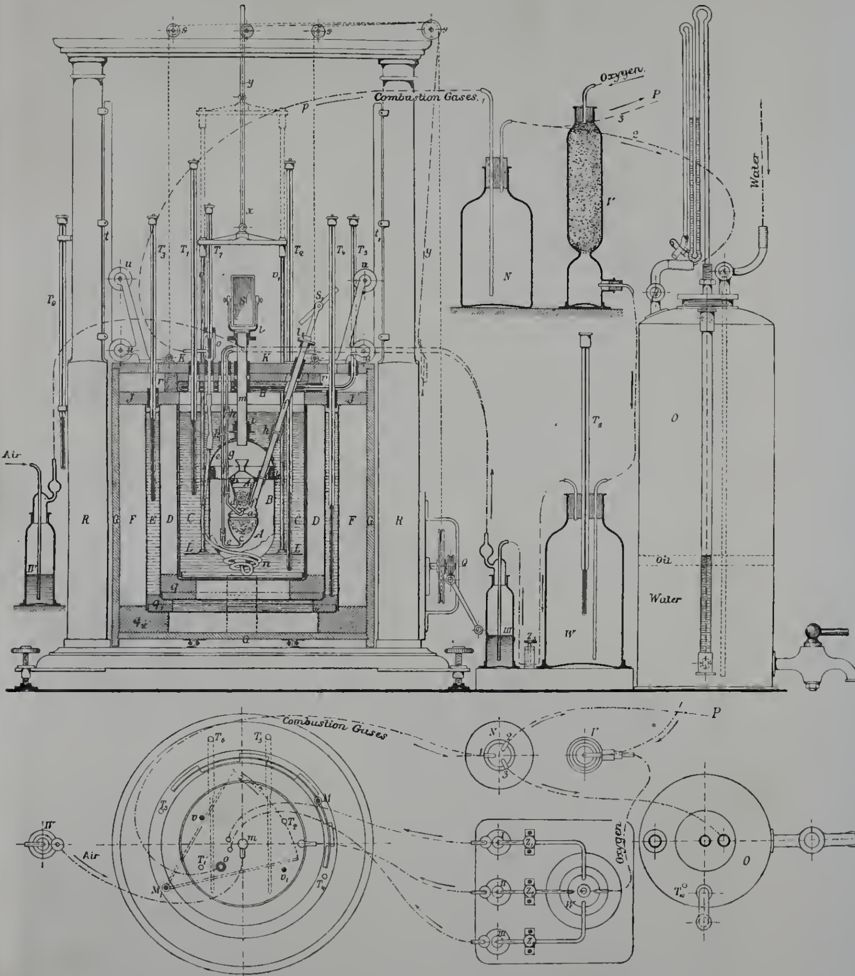
The inventor recommends the absorption of ammonia derived from furnace gases by calcium chloride. The mixture of calcium carbonate and ammonium chloride formed is either to be used as an ammoniacal manure, or by heating sesquicarbonate of ammonia can be obtained, which is to be employed in the ammonia soda process. —S. H.

Improvements in Gas Producers and in Fuel-supplying Devices used in connection therewith. J. G. Wilson, Manchester. From J. E. Bott, U.S.A. Eng. Pat. 6764, April 24, 1884.

The novelty of this invention consists mainly in the manner of admitting the air necessary for ensuring complete combustion of the fuel undergoing destructive distillation in gas producers, continuous corrugated tuyeres injecting air, or air and steam, being employed, which supply the fuel with a continuous blast of steam. This by means of the variable vertical section of the waved tuyeres causes the blast to permeate a larger vertical, as well as horizontal mass of incandescent fuel, thus ensuring a uniform combustion taking place, and the distillation of the fuel into gas proceeding regularly, whilst the residue is left in a more friable form than is possible when blast is admitted in the form of concentrated jets through isolated tuyeres, for in the latter case combustion proceeds irregularly, and the tendency is to form clinkers in the immediate vicinity of the tuyeres whilst the gas is produced in flushes.—D. B.

Improvements in the Purification of Coal Gas or of other Gases Containing Ammonia or Ammoniacal Compounds. A. P. Price. Eng. Pat. 6983, April 29, 1884.

The purification of the gas is effected by means of the hydrogen sulphates, sulphites or phosphates of potassium, sodium, or ammonium, either in a divided condition or in solution, whereby the ammonia existing in the ammoniacal products contained in the gas is absorbed, and may be subsequently recovered from the resulting compound.—D. B.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Improvements in the Production of Combustible Gases from Finely-pulverised Coal, Peat, Wood-sawdust, or other Material. F. J. Jones, Worcester. Eng. Pat. 915, January 22, 1885.

This invention relates to the production of heating or illuminating gas, and consists essentially in passing a regular supply of finely-pulverised coal, peat, etc., through an hermetically closed chamber of suitable construction provided with the necessary inlets and outlets, and heated to a temperature sufficient for evolving combustible gases from the materials introduced.—D. B.

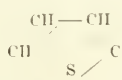
III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Presence of High-boiling Phenols in Coal-tar. K. E. Schulze. Ber. **18**, 150.

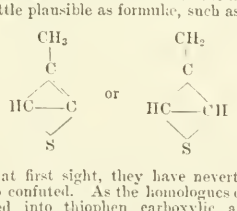
The author has isolated α- and β-naphthol from "green oil"—anthracene oil from which the crude anthracene has been extracted by filtration—and gives a detailed account of the process employed (*Ann.* 227, 143).—D. B.

Constitution of Thiophen Compounds. V. Meyer. Ber. **18**, 526-529.

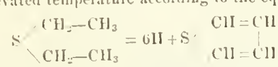
The essential points to be considered in proving the correctness of the formula



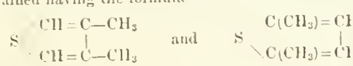
assigned to thiophen are (1) the number of isomeric substitution products of thiophen; (2) its property to form addition products; (3) the position of the sulphur atom; and (4) the behaviour of thiophen when subjected to oxidation. Referring to the position of the sulphur, which can be conceived to be combined in no other form than that of C – S or C – S – C or C – S – H, the author is of opinion that, taking into account the fact that thiophen is neither a thioketone, thioaldehyde, or mercaptan, there can no longer be any doubt as to the meaning expressed by its formula. The assumption that thiophen occupies the same position among its homologues as that held by benzene among the aromatic hydrocarbons requires, however, additional proof, which can be adduced only by taking into consideration the property which thiophen exhibits when subjected to oxidation. Although not yet finally decided, it is very probable that thiophen represents the first member of the homologous series, and little plausible as formulæ, such as—



may appear at first sight, they have nevertheless not been hitherto confuted. As the homologues of thiophen are converted into thiophen carboxylic acid, when oxidised with potassium permanganate, it remained to be shown that when thiophen is similarly treated no acid is obtained which contains the same amount of carbon, or has the properties characterising a thiophen derivative. On oxidising pure thiophen with potassium permanganate, fatty acids and sulphuric acid were obtained. The substituting action of bromine and chlorine on thiophen is so energetic that the isolation of the resulting addition products is attended with great difficulties, and should the same be found to apply to the iodine addition products, the best mode of procedure will probably be to prepare the mellitic acid of thiophen—tetra-carboxylic acid—and reduce it with sodium amalgam. Should the resulting acid take up four atoms of hydrogen, this circumstance would confirm the assumption of two double unions, seeing that mellitic acid takes up double the number of hydrogen atoms compared with the number of double unions it contains. It is therefore intended to prepare a tetralkylthiophen and convert it into the acid in question by treatment with potassium permanganate. Referring to the number of isomeric substitution products, the author is of opinion that should it be shown that the mono-derivatives are obtainable in two modifications only, this again would prove the correctness of the formula for thiophen. In the preparation of the sulphonic and carboxylic acids of thiophen and of methylthiophen, only two modifications have as yet been observed, a circumstance which should however be verified by further research. It is of especial importance to obtain means for ascertaining the position of the substituted group in the thiophen molecule. In a previous communication, the formation of the anhydride of a disulphonic acid, and the assumption that dibromothiophen is analogous in constitution to para-dibromobenzene, formed the basis of the author's speculations. He is continuing his researches in this direction. The three dicarboxylic acids of benzene being distinguished by characteristic properties, it was thought that by studying the behaviour of thiophen dicarboxylic acids it might be possible to observe an analogy between them and the three phthalic acids, and thus determine the position of the carboxyl groups. At the author's instigation, Jaekel prepared a dicarboxylic acid from the disulphonic acid according to Merz's reaction. An acid was obtained which, although not yet fully examined, appeared to be the terephthalic acid of thiophen. In conclusion, the author suggests a mode by which the position of the sulphur in the thiophen group might be definitely determined. It has been shown that ethyl-sulphide is converted into thiophen at an elevated temperature according to the equation:



Should it be possible to apply the same reaction to propyl and isopropyl sulphide, two thioxylenes should be obtained having the formulæ—



—D. B.

Nitrothiophens. O. Stadler. Ber. **18**, 530-536.

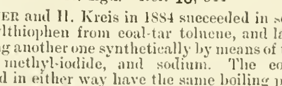
In a former communication it was shown that on distilling dinitrothiophen melting at 52°, by means of steam, a substance is obtained which melts at a higher temperature. The author has continued his researches in this direction, and finds that the substance has a constant melting point of 78°, and crystallises from water or alcohol in yellow needles. It is an isomeric dinitrothiophen $C_4SH_2(NO_2)_2$. By the action of bromine on dinitrothiophen at an elevated temperature, a substance is obtained which crystallises in white lustrous needles, melting at 112°. It is not a bromine derivative of dinitrothiophen, but represents tetrabromothiophen, the two nitro groups having been removed by the action of bromine at a high temperature. The author has studied the sensitiveness of the colour reaction which dinitrothiophen gives with alcohol and potash, and finds that it is distinctly discernible in a solution containing 0·0000001grm. of substance. Mononitrothiophensulphonic acid, $NO_2 - C_4SH_2 - SO_3 -$, was prepared by treating three parts of mononitrothiophen with eight parts of fuming sulphuric acid. It gives white hygroscopic crystals, which are resolved into mononitrothiophen when heated. The potassium salt crystallises in grey shining needles, and the calcium salt forms a white crystalline mass.

C

The sulphonic chloride, $NO_2 - C_4SH_2 - SO_2Cl$, was prepared by heating the potassium salt with phosphorus pentachloride on a water bath. It was converted into the sulphonamide $NO_2 - C_4SH_2 - SO_2.NH_2$ by treatment with ammonium carbonate. The sulphonamide melts at 172-173°.—D. B.

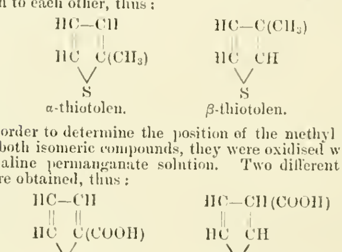
On the Two Isomeric Thiotolens (Methylthiophens). K. Egli. Ber. **18**, 544

V. Meyer and H. Kreis in 1884 succeeded in separating a methylthiophen from coal-tar toluene, and later on in obtaining another one synthetically by means of thiophen-iodide, methyl-iodide, and sodium. The compounds produced in either way have the same boiling point, and the author investigated the question as to whether they are identical or isomeric. For this purpose the bromine derivatives of both thiotolens were compared with each other, when it was found that their fusing point invariably differed by 12 degrees. They must therefore have a different constitution. This result is quite in accordance with V. Meyer's view on thiophen and its derivatives. In one thiotolen the methyl group and sulphur have the α position, in the second the β position to each other, thus:



α-thiotolen. β-thiotolen.

In order to determine the position of the methyl group in both isomeric compounds, they were oxidised with an alkaline permanganate solution. Two different acids were obtained, thus:



α-thiophenic acid. β-thiophenic acid.

Their bromine substitution product was also prepared. The final result of the investigation is as follows: Thiophen obtained from coal-tar toluene is isomeric, but not identical with that produced synthetically. In the former the methyl group is in the α position, in the latter it is in the β position.—S. H.

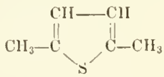
Isomeric Thiophensulphonic Acids. J. Langer. Ber. **18**, 553-563.

Dibromothiophenmonosulphonic acid $C_4SHBr_2SO_3H$.—The lead-salt of this acid, formerly described, was converted into the sodium salt, and the latter dried at 120°, and treated with phosphorus pentachloride. The resulting chloride was converted into the amide by treatment with ammonium carbonate. It crystallises in fine needles melting at 146·5-147°. To prepare the *free β-thiophenmonosulphonic acid* $C_4SH_3SO_3H$, the sulphonic chloride described in a previous communication was decomposed by boiling with water, and the liberated hydrochloric acid precipitated with silver hydroxide. The solution was treated with sulphuretted hydrogen, filtered and the filtrate evaporated. A white crystalline mass of strongly acid reaction was obtained. It gave a deep blue coloration when heated with isatin and sulphuric acid. *Barium β-thiophenmonosulphonate* $(C_4SH_3SO_3)_2Ba$ was prepared by saturating the aqueous solution of the free acid with barium carbonate. *Debromination of dibromothiophendisulphonic acid.*—By treating the sodium salt of this acid with sodium amalgam, and adding phosphorus pentachloride to the debrominated substance, the chloride of a new thiophendisulphonic acid was obtained *β-thiophendisulphonic chloride*, $C_4SH_2(SO_2Cl)_2$, crystallises in small plates or laminæ melting at 148-149°. It is readily soluble in ether, has the odour which characterises this class of bodies, and gives a bluish violet solution when heated with isatin and sulphuric acid. *β-thiophendisulphonamide* $C_4SH_2(SO_2NH_2)_2$ was prepared by the action of ammonium carbonate on the sulphonic chloride. It crystallises in white needles melting at about 280°. *Dibromothiophendisulphonic chloride* $C_4SBr_2(SO_2Cl)_2$ was obtained by treating sodium dibromothiophendisulphonate with phosphorus pentachloride. It crystallises from ether in white shining needles, which melt at 215°. *Dibromothiophendisulphonamide* $C_4SBr_2(SO_2NH_2)_2$ was prepared by intimately mixing and heating the sulphonic chloride with solid ammonium carbonate. It is sparingly soluble in hot water, and melts at about 270°. *Lead dibromothiophendisulphonate* $C_4SBr_2(SO_3)_2Pb$ was obtained by converting the anhydride of the acid into the barium salt, decomposing the latter with sulphuric acid, and adding a salt of lead to the filtrate. *Sodium dibromothiophendisulphonate* $C_4SBr_2(SO_3Na)_2 + 3H_2O$ was prepared by heating the anhydride of dibromothiophendisulphonic acid with soda ley. It crystallises in silky needles which are readily soluble in water. *Ammonium dibromothiophendisulphonate* $C_4SBr_2(SO_3NH_4)_2 + H_2O$ was obtained by boiling the anhydride with ammonia. To prepare the *free dibromothiophendisulphonic acid* $C_4SBr_2(SO_3H)_2$ an aqueous solution of the lead salt described in the above was precipitated with sulphuretted hydrogen and filtered. On evaporating the filtrate the free acid was obtained in the form of a solid crystalline white mass readily soluble in water. *Sulphonation of monoiodothiophen.* The author has attempted to prepare a monoiodothiophensulphonic acid, but has not yet obtained successful results. He has, however, deiodated the disulphonic acid by treating its aqueous solution with sodium amalgam. The sulphonic acid was purified by conversion into its chloride, and as the latter contained traces of free iodine it was treated with ammonium carbonate to form the amide. *β-thiophendisulphonamide* $CSH_2(SO_2NH_2)_2$ crystallises in laminæ melting at 142°. It is sparingly soluble in water, and gives a deep blue solution when heated with isatin and concentrated sulphuric acid. *β-thiophenmonosulphonamide* $C_4SH_3SO_2NH_2$ was prepared be converting the barium monosulphonate $(C_4SH_3SO_3)_2Ba$ into the sodium salt, and treating the latter with ammonium carbonate. It crystallises from water in white laminæ which melt at 147°.—D. B.

Thioxen from Coal-tar. J. Messenger. Ber. **18**, 563-568.

Some time ago V. Meyer proved the existence of a thiophen derivative in coal-tar xylene, and gave it the name "thioxen," and the formula $C_4SH_2(CH_3)_2$. The author has isolated this substance, and investigated its properties. It was prepared from the acid used in the purification of xylene, which contains about 40 per cent. of pure thioxen. The product is a colourless liquid, boiling between 133° and 138°. *Dibromothioxen* $C_4SBr_2(CH_3)_2$, was prepared by adding 50grm. bromine to 50grm. crude thioxen (2mol. Br. to 1mol. thioxen), washing the product with water, boiling it with an alcoholic solution of potash to decompose the bromine addition products formed, then pouring the mass into water, and separating the oil. The latter was distilled with steam, and the distillate fractionated. The first portion boiling between 135° and 165°, consisted mainly of xylene. The second fraction boiling between 205-215°, gave, on redistillation, a liquid boiling at 197-199°. It was composed of a mixture of equal parts of monobromothioxen and monobromothioxen, and could not be separated. The last fraction boiled between 240-250°, and gave a distillate which solidified in the receiver. It was crystallised from alcohol, and yielded long colourless needles, melting at 46°, and boiling between 246-247°, without decomposition. The substance was dibromothioxen. *Octobromothioxen*, $C_4SBr_2(CBr_3)_2$, was obtained from dibromothioxen by treatment with bromine until the latter ceased to react. It crystallises from alcohol in yellow needles, which melt at 114°. *Thioxen* $C_4SH_2(CH_3)_2$. For the isolation of pure thioxen, the method adopted by Meyer and Kreis for separating thiotolen from a mixture of toluene and thiotolen was employed. The pure product is a colourless mobile liquid, of agreeable

odour, boiling at 136-137·5°. By the oxidation of thioxen with potassium permanganate, thiophendicarboxylic acid $C_6H_4SO_4$ was obtained. The latter is sparingly soluble in water, but dissolves more readily in ether. Heated to 350°, it does not melt, but sublimes without decomposition. This acid, therefore, appears to be analogous in character to the isophthalic acid in the benzene group, but judging from the melting point of its dimethyl-ether (142°), it is more probably analogous to terephthalic acid. If this be the case, the formula for thioxen would have to be expressed thus—



—D. B.

Fractional Distillation by means of Steam. M. J. Lazarus. Ber. **18**, 577.

The object was to separate two mixed liquids, one of which was very volatile, whilst the other suffered decomposition at a comparatively low temperature. Naumann has shown that liquids, not miscible with water, when distilled with steam, boil below the temperature at which water boils. The author has, therefore, distilled a number of mixed liquids with steam to ascertain whether they could be fractionated in this manner. The distillation was effected with a moderately powerful pressure of steam, and the distillate collected in two or three fractions. Each fraction was then dried, and fractionated *per se* to ascertain its composition.

Experiment 1.—25cc. toluene and 25cc. nitrobenzene.

Fraction.	Temperature.	Volume.	Toluene.	Nitrobenzene.
1	90-95°	21cc.	19cc.	——
2	95-98°	6cc.	3·5cc.	——
3	98°	23cc.	——	23cc.

Recovered: 22·5cc. toluene and 23cc. nitrobenzene.

Experiment 2.—25cc. benzene and 25cc. nitrobenzene.

Fraction.	Temperature.	Volume.	Benzene.	Nitrobenzene.
1	96°	23·5cc.	22·00cc.	——
2	96-98°	4·0cc.	1·75cc.	——
3	98°	22·5cc.	——	22·5cc.

Recovered: 23·75cc. benzene and 23·5cc. nitrobenzene.

Experiment 3.—30cc. nitrobenzene and 5cc. toluene.

Fraction.	Temperature.	Volume.	Toluene.	Nitrobenzene.
1	95-98°	6cc.	4·25cc.	——
2	98°	29cc.	——	29cc.

Recovered: 4·25cc. toluene and 29cc. nitrobenzene.

Experiment 4.—25cc. toluene and 25cc. xylene.

Fraction.	Temperature.	Volume.	Toluene.	Xylene.
1	84-91°	22cc.	16·5cc.	2cc.
2	91-98°	28cc.	3·0cc.	18cc.

Recovered: 19·5cc. toluene and 20cc. xylene.

Experiment 5.—25cc. benzene and 25cc. carbon-disulphide.

Fraction.	Temperature.	Volume.	Carbon-disulphide	Benzene.
1	64°	22	19cc.	——
2	64-67°	6	3cc.	——
3	67°	22	——	21·5cc.

Recovered: 22cc. carbon-disulphide and 21·5cc. benzene.

Experiment 6.—25cc. oil of turpentine and 25cc. nitrobenzene.

Fraction.	Temperature.	Volume.	Oil of Turpentine.	Nitrobenzene.
1	95-97°	21cc.	19cc.	——
2	97-98°	4cc.	2cc.	——
3	98°	25cc.	——	24cc.

Experiment 7.—25cc. aniline and 25cc. nitrobenzene.

The mixture distilled at 98°, and was collected in two fractions, each measuring 25cc. The first contained 15cc. aniline and 10cc. nitrobenzene, and the second 10cc. aniline and 15cc. nitrobenzene. Benzene and toluene could not be separated perfectly, even when large quantities were operated on. The author has used this process with success for the separation of iodothiotolen and toluene and iodothioxen and xylene, an operation which has hitherto been attended with great difficulties and much loss, owing to the decomposition of the iodine compounds at comparatively low temperatures.

—D. B.

Occurrence of Carboxylic Acids in Coal-tar. K. E. Schulze. Ber. **18**, 615.

Hitherto bodies of the phenol group only have been shown to exist in the oxygenated constituents of coal-tar, of which phenol and α- and β-naphthol have been isolated, whilst the presence of cresols, xylenols, etc., has been inferred from isolated derivatives of these compounds. In pursuing his investigations on the high-boiling phenols of coal-tar, the author discovered a carboxylic acid, which was found to be benzoic acid. It was isolated in the following manner:—In order to obtain cresols and xylenols, the residues from the distillation of phenol were subjected to fractional distillation. The last portions came over between 235° and 240°, and from this boiling point the author inferred the presence of pseudocumenols, of which there are three isomers. To separate the latter, the oil was treated with soda ley, and distilled with steam. The residue contained the sodium salt of the strongest acid present in the mixture. On adding sulphuric acid, a brown-coloured oil was liberated, which, on cooling, solidified in the form of needles, melting at 123°, and boiling at 249·2°. The silver salt was prepared, and its formula agreed closely with that of silver benzoate, $C_7H_5O_2Ag$. 100grm. of crude material gave 8grm. of recrystallised benzoic acid. As to the formation of this acid, the author states that it cannot be produced by any of the processes in vogue for preparing carbolic acid; he is, moreover, of opinion that it is contained in the products of the distillation of coal-tar, and passes into the carbolic acid during the treatment of the oil with soda ley. —D. B.

Thiophen from Erythrol. C. Paul and J. Tafel. Ber. **18**, 688.

It has recently been demonstrated that the group CHOH – CHOH – CHOH – CHOH, which is contained in pyromucic acid, passes into the thiophen ring on treatment with sulphuretted hydrogen. The simplest body in which this complex of atoms is found is erythrol, $CH_2OH - CHOH - CHOH - CH_2OH$, which on heating with phosphorus pentasulphide gave thiophen.—D. B.

Remarkable Formation of Anthracene. H. Köhler. Ber. **18**, 859.

In a communication on high-boiling phenols contained in coal-tar, Schulze expressed the opinion that the phenols are the primary products of the destructive distillation of coal. By continuing the action of heat they are partly split up, water being liberated and high-boiling hydrocarbons formed, whilst another portion is reduced to low-boiling hydrocarbons, or is eventually converted into coal-gas through the complete disintegration of the molecules. A portion resists decomposition by heat at the point at which the various reactions reach an equilibrium. Schulze arrived at this theory by the observation that the phenols separated from anthracene oil when subjected to distillation yield liquid hydrocarbons with partial liberation of water. Some time ago the author made an observation which appears to confirm to some extent Schulze's view. In working up the high-boiling portions of crude carbolic acid, a cast-iron still was charged with "carbolic residues," which distilled above 205°. They were free from hydrocarbons, and gave a clear solution with caustic soda. On distillation about two-thirds passed over in the ordinary way as a pale yellow-coloured oil, having the odour peculiar to phenol. After this the thermometer rose rapidly above 300°, and from the condenser dense white fumes issued, whilst the distillate in the receiver assumed a consistence like that of butter. On opening the still it was found to be half-

filled with a spongy mass of coke. The distillate was washed with alkali to remove the liquid constituents (phenols), and was tested for anthracene by Luck's method, which gave thirty-five per cent. of pure anthracene. The presence of methylanthracene, phenanthrene, etc., in the crude product was established by its properties. The author then made a number of distillations in the same boiler, but failed to obtain anthracene. He is of opinion that the decomposition was caused by local superheating in the still. The probability of this assumption is strengthened by the fact that the crude carbolic acid in question had been obtained from light oil, which contains phenols of such complicated constitution that it would be difficult to conceive the formation of anthracene therefrom by the mere liberation of water; moreover, the whole course of the reaction—production of large quantities of non-condensible substances and separation of coke—points to a more complex decomposition. Be this as it may, the fact can no longer be doubted that under suitable conditions anthracene can be formed from phenolic bodies extracted from the light-boiling portions of coal-tar.

Many chemists are of opinion that the greater part of the anthracene obtainable from coal-tar is produced during the process of distillation, whilst it has been found that the yield of anthracene varies according as the fire is allowed to play round the whole or only part of the still. This view appears to be supported by the author's observations.—D. B.

Synthetical Lutidine. W. Epstein. Ber. **18**, 883.

In consequence of a recent communication made by Haitinger concerning the production of a lutidine melting at 147-151° from derivatives of dehydracetic acid, the author states that in investigating the derivatives of a body obtained by the aid of the condensation of acetoacetic ether with aldehyde ammonias, according to Hantzsch's method, he obtained a lutidine melting at 145-146°. It is different in properties to orthoparadimethylpyridine (m.pt. 154-155°), first prepared by Hantzsch from lutidinetricarboxylic acid, and subsequently in larger quantities from pseudolutidostyril. It differs also from Ladenburg and Roth's lutidine (m.pt. 142-143°), found in commercial picoline. The platinochloride of the author's lutidine melts at 216°, the aurochloride at 119°, the picrate at 161°, the dichromate at 92°, and the mercuro-chloride at 155°.—D. B.

Caucasian Petroleum. P. Milkowsky. J. Russ. Phys. Chem. Soc. 1885 [2], 37.

The author has subjected the portion of Bibi-Eibat and Balachany petroleum boiling between 85° and 105° to a succession of fractional distillations over sodium, and obtained the following products:—

	90-91°	93-94°	96-97°	100-101°
Sp. gr. at $\frac{0°}{0°}$ ..	0·7476	0·7524	0·7650	0·7778
" " $\frac{17·5°}{0°}$ ..	0·7320	0·7390	0·7515	0·7624
Vapour density	3·65	3·55	3·57	3·57

The fraction boiling between 100° and 101° was heptanaphthene, C_7H_{14}. By passing chlorine through this hydrocarbon at the ordinary temperature, 72·8 per cent. of chlorides lighter than water, and 27·2 per cent. of chlorides heavier than water, were produced, whilst at an elevated temperature 58 per cent. of heavy, and 42 per cent. of light, chlorinated derivatives were formed. Bromine acts readily on heptanaphthene, whilst iodine dissolves therein without further action.—D. B.

Examination of Caucasian Petroleum. W. Markownikow. J. Russ. Phys. Chem. Soc. 1884 [2], 294.

Octonaphthene.—This hydrocarbon has already been isolated from Balachany petroleum, and the author has recently extracted it from the petroleum which occurs at Bibi-Eibat. It boils at 119°, has a sp. gr. of 0·7649 at $\frac{0°}{0°}$, and 0·7503 at $\frac{18°}{0°}$, and is composed of 85·3 per cent. of carbon, and 14·7 per cent. of hydrogen. When chlorinated according to Schorlemmer's method, a number of isomeric chlorides are obtained. The chloride boiling at 174-176° was heated to 60° with dry calcium iodide, and the resulting iodide converted into the ether of the octonaphthenealcohol by treatment with silver acetate. The ether boils at 196-200°. The iodide prepared from the chloride boiling between 169-172° was converted into octonaphthylene, $C_{18}H_{14}$, by treatment with moist oxide of silver. It boils at 118-121°, and gives a liquid brominated derivative, $C_{18}H_{14}Br_2$. M. Putochin has obtained iso-octonaphthene from the intermediate products formed in the isolation of octonaphthene and nononaphthene by repeated fractionation over sodium, and treatment with fuming sulphuric acid. It boils at 122-124°, and has the formula $C_{18}H_{16}$. Its sp. gr. is 0·7768 and 0·7765 at $\frac{0°}{0°}$, and 0·7637 at $\frac{17·5°}{0°}$. The chlorinated derivatives have higher boiling points than the corresponding derivatives of octonaphthene. In order to obtain iso-octonaphthylene boiling at 128-129°, the chlorinated derivative is treated with an alcoholic solution of potash.—D. B.

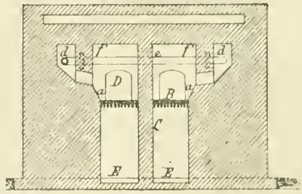
Anthracene in Tar from Water-gas. Arthur H. Elliott. Amer. Chem. J. **6**, 248-252.

In the fraction of water-gas tar boiling at 210-230° (product of the destructive distillation of light petroleum naphtha), 5·8 per cent. of anthracene was found, and 2·08 per cent. in the higher boiling fractions. The total yield from the original tar amounted to 2·6-2·9 per cent. —J. B. C.

Improved Apparatus for Carbonising Bones and Turf, and for Coking and Distilling Brown Coal, Pit Coal, and other Carbonaceous Materials by means of Superheated Steam. B. J. B. Mills, London. From A. Zwillinger, Vienna. Eng. Pat. 6995, April 29, 1884.

The apparatus employed for carrying out this invention is principally composed of a furnace A (Figs. 1, 2 and 3), for superheated steam, several cast-iron retorts communicating with a common condenser, and of a gasometer of the usual form. The fireplace of the furnace is divided into two chambers, so that it is heated by two separate fires, and along both sides of the flue conduits are formed in the brickwork, communicating with the flue

Fig 1.



at certain intervals by means of small apertures. The steam pipes *c* rest in two vertical walls, so that the elbow joints *d* are placed right and left in narrow channels f_1, which are in connection with the furnace proper by narrow flues f_2. The steam enters at *g*, and after traversing the heated pipes *c*, it passes through pipes *h* and branches h_1, which are provided with many small holes, into cast-iron cylinders G, containing the material to be treated. The fire-gases travel through a flue *k* into an annular space *j*, heating thus the steam pipes and the cylinders G, and escape at *l* into the chimney. The vapours and gases evolved in G are conveyed to a condenser H, and thence through *n* to coolers. The

admission of air to the fire-places can be carefully regulated by means of slides in the ash-pit doors c, and in order to prevent the destruction of the cast-iron pipes c and cylinders G by oxidation, they are covered with a fire-proof material, consisting of 120 parts fire-clay, 40 parts animal charcoal and 2 parts cow-hair.—S. H.

Fig 2.

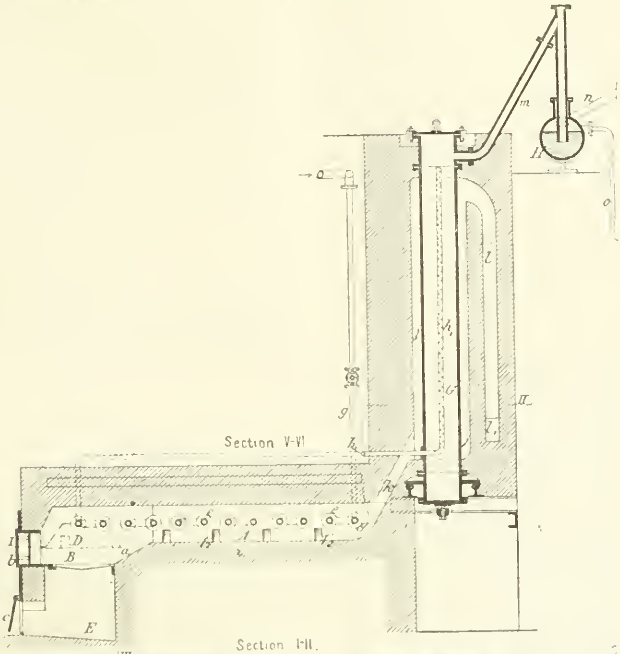
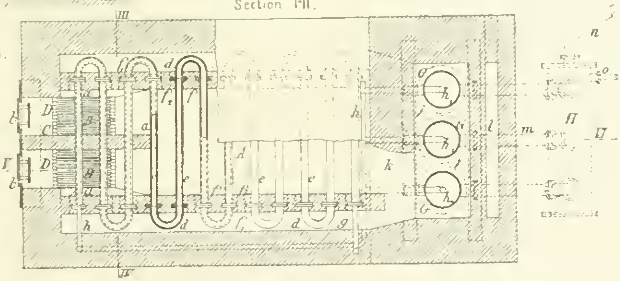


Fig 3.



Improvements in Apparatus for Distilling Shales and the Like. R. Bell, Broxburn, Scotland. Eng. Pat. 9285, June 21, 1884.

The inventor proposes to build a furnace, erect over the same the lower chamber of the retort, and mount over the latter the upper chamber. Surrounding these chambers is an outer wall, the intervening space being in communication with the furnace by suitable openings. In the lower part of the bottom chamber there is a shoot which passes in a downward direction at the side of the outer wall, and opens into the furnace beneath, and through it the contents of the bottom chamber of the retort are discharged into the furnace to further utilise their heat. Between the chambers of the retort a valve or slide is arranged, which can be operated from the outside of the apparatus to allow the contents of the upper chamber to pass into the chamber below as required. The retort is provided with openings and pipes for the outlet of the volatile products of distillation at different levels.—D. B.

Improvements in the Treatment of Oils and Tars obtained from Coke Ovens, for the Production of Valuable Hydrocarbons. C. E. Bell, Durham. Eng. Pat. 9510, June 27, 1884.

At the present time oils and tars are obtained from coke ovens which do not contain in their natural state any considerable proportion of benzene, naphthalene, anthracene, etc. By passing these oils in the state of vapou through retorts charged with coke heated to redness, the inventor claims to obtain large quantities of hydrocarbons of the above series.—D. B.

Improvements in the Treatment of the Gases from Coke Ovens for the Recovery of Bye-products therefrom, and in Apparatus for that Purpose. H. Simon, Manchester. From F. Carvés, St-Etienne, France. Eng. Pat. 15,920, December 3, 1884.

THIS invention relates to coke ovens, more particularly those known as the Simon-Carvés coke ovens, wherein the combustible gases generated in the coking chambers are first treated for the separation of tar and ammoniacal liquor, and are then used as gaseous fuel. According to the present invention, the gases before being burned are subjected to a further treatment, whereby the inventor separates from them the light hydrocarbons which are still retained in a gaseous form therein. For this purpose, the gases, after purification from ammoniacal and other easily condensible constituents, are subjected to the intimate action of heavy oils capable of absorbing the light hydrocarbons, the oils being then heated or otherwise acted on so as to separate from them the light hydrocarbons. The various parts of the apparatus for effecting the separation of the light hydrocarbons are described and illustrated in the original.—D. B.

An Improved Process of Manufacturing Benzene and its Homologues by the Distillation of Coal, Wood, Turf, Oil and other similar Substances. N. A. Hélouis, Paris. Eng. Pat. 6904, April 28, 1885.

THIS patent is similar in principle to a former invention, for which the author obtained provisional protection only. (See this Journal, vol. iii. p. 438).—D. B.

IV.—COLOURING MATTERS AND DYES.

*Process for the Production of Indigo.** Dingl. Polyt. J. **255**, 356.

ACCORDING to H. Müller (Ger. Pat. 30,329, June 12, 1883), benzaldehyde is chlorinated in presence of a dehydrating agent, and meta-chlorbenzaldehyde obtained as a colourless liquid of 1·246 relative density at 15°, and boiling at 206°. By the nitration of this compound, metachlor-orthonitrobenzaldehyde is formed and may be precipitated from the nitrating mixture with ice-cold water; crystallised repeatedly from alcohol, it forms yellowish needles, melting at 60°. By dissolving metachlor-orthonitrobenzaldehyde in acetone, and adding to this solution first a little water, then dilute soda-lye, a formation and separation of chlorindigo takes place in a short time. The chlorindigo thus prepared closely resembles pure indigo; it is a deep blue crystalline powder with coppery lustre, without taste or smell, insoluble in water, alcohol, and ether, dilute acids, and alkalies, somewhat soluble in hot chloroform, aniline, and benzalchloride. When heated, chlorindigo sublimes with partial decomposition; distilled with sodium hydrate, it breaks up into carbonic acid and chloraniline. Treated with concentrated sulphuric acid, it forms a sulphonic acid soluble in water, which dyes wool blue. Treated with reducing agents, chorindigo yields a vat which may be employed in the same manner as that from ordinary indigo. Chlorindigo exposed to the action of nascent hydrogen is converted into indigo.—W. D. B.

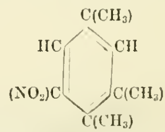
Azo-dyes. Soc. Anon. de Matières Colorantes de St-Denis. Dingl. Polyt. J. **255**, 404.

AZO-DYES which impart a pure yellow to vegetable fibres capable of resisting a soap bath of 60°, are obtained (Ger. Pat. 29,991, March 25, 1884) by the action of para- or meta-diazobenzoic acid on diphenylamine or monobenzylaniline. For example, 5kilos. sodium para- or meta-amidobenzoate are dissolved in 200 litres of water, and 6·6kilos. of a 33 per cent. solution of sodium nitrite are added. The mixture is acidified with 9·4 kilos. of sulphuric acid of 53° B. previously diluted with water; and care is taken, by the addition of ice, to keep the temperature below 20°. This mixture is then poured upon 5·3kilos. diphenylamine or monobenzylaniline, which is suspended in 170 litres of acidified water. After four to eight days the reaction is complete. The insoluble dye is filtered, washed and dried. The dye produced by the meta-compound is yellower than that produced by the para-compound; the latter approximates more to orange yellow. To apply this dye to cotton goods, the dye is thickened with starch or tragacanth, and then with the necessary quantity of alkali to convert the acid dye into a salt. On boiling, cooling and adding excess of acetic acid, the insoluble acid dye is again set free, but in a condition suitable for fixing on the goods. Chromium acetate serves best as mordant. After printing the goods are steamed. The dye retains its brightness in a soap bath heated to 60°. To obtain a bright yellow after simple washing with water, an aluminium salt is used as mordant. The yellow dye obtained with chromium mordant combines very well with artificial alizarin red. —J. T.

* See also this Journal, iii. 411.

Nitropseudocumene, Pseudocumidine and Pseudocuminol (1, 3, 4, 5). E. Edler. Ber. **18**, 629.

THE derivatives of pseudocumene known up to the present have the symmetrical position 1, 3, 4, 6. The author prepared the isomeric compounds, whose constitutional formula may be represented by the nitropseudocumene, thus—



With this object in view, the common pseudocumidine was first converted into the acetyl and thence into the nitro compound. After separating the acetyl group and treating the resulting nitropseudocumidine with nitrous acid and alcohol, a nitropseudocumene was obtained. In order to determine its constitution, the nitroacetylpseudocumidine

$$C_6H(\overset{1}{C}H_3)(\overset{3}{C}H_3)(\overset{4}{C}H_3)(\overset{5}{N}O_2)(\overset{6}{N}H)(C_2H_3O)$$

was reduced, whereby a base was produced whose hydrochloride had the following composition—

$$C_6H(CH_3)_3\left\langle\begin{matrix} NH.C.CH_3 \\ \| \\ N \end{matrix}\right. .HCl.$$

The author concludes that as it was found impossible to split off the acetyl group with alcoholic potassium hydrate, the nitro and amido group in nitropseudocumidine must be in the ortho position to each other. This conclusion proved correct, when by reducing nitropseudocumidine a base pseudocumylenediamine,

$$C_6H(CH_3)_3(NH_2)_2$$

was obtained, which had all the characteristic properties of an ortho-diamine, as stated by Ladenburg (Ber. xi. 600 and 1650).—S. H.

Preparation of Nitrosonaphthols. R. Henriques and M. Ilinski. Ber. **18**, 704.

β-Naphthol: 1 part commercial β-naphthol and 0·75 part zinc chloride are dissolved in 6 parts alcohol; 0·5 part sodium nitrite dissolved in little water is then added to the boiling alcoholic solution. The liquid turns red, and whilst the boiling is continued the red brown zinc salt separates out. On standing at rest over night, the salt is filtered and washed with alcohol. It is then suspended in 10 parts water and digested for a short time with 0·8-1 part caustic soda until it has been converted into the green crystallised sodium salt. The latter is filtered, washed with water and decomposed at the common temperature with hydrochloric acid. The nitrosonaphthol thus obtained, after filtering and washing, is almost chemically pure, and needs no further purification for the use as reagent. The yield is 110% to 115% of the β-naphthol used.

α-naphthol: A similar treatment of the α-naphthol for obtaining nitroso-α-naphthol is not advisable, the α naphthol not being easily attacked by nitrites of metals. In order to produce the α-derivate in an almost pure state, a solution of 1 part commercial α-naphthol and 1 part zinc chloride in 6 parts alcohol is heated to the boil. A concentrated aqueous solution of 0·5 part sodium nitrite is added, and the boiling continued for two to three hours. After standing over night, the red zinc salt of β-nitroso-α-naphthol separates out, which is, however, permeated with fine yellow needles of α-nitroso-α naphthol, whose zinc salt is decomposed by boiling with alcohol. The mass is filtered, washed with cold alcohol, and the two nitrosonaphthols are separated with an alcoholic potassium hydrate solution (Ber. xvii. 2590) without previously decomposing the zinc salt with hydrochloric acid. The alcoholic filtrate contains undecomposed α-naphthol and α-nitroso-α-naphthol. A large quantity of water is added, when only the nitroso compound separates out, whereas α-naphthol does not crystallise out but after some time. The precipitate is filtered immediately and washed with water. The nitrosonaphthol, thus precipitated, is nearly as pure as that previously prepared from the residual mixture. If it contains some impurities or traces of undecomposed α-naphthol it is washed with benzene. 100grm. naphthol yielded 50gr. yellow (β) and 40gr. white (α) nitroso-naphthol.—S. H.

Colouring Matters from Lepidine. S. Hoogewerff and W. A. van Dorp. Rec. Trav. Chem. **3**, 337-362.

The present paper is a continuation of the authors' previous researches, and also the results of their investigations on cyanine and on a new colouring matter first obtained by Spalteholz.

Dimethylcyanine-chloride is obtained from the corresponding iodide by the action of AgCl. Diethylcyanine-bromide can be prepared in the same manner as the iodide from diethylquinolinebromide and ethyllepidine-bromide, and dissolves in alcohol with a pure blue colour, which is not fast to light or carbonic acid. By the action of potash upon the iodides of methyl-*p*-toluquinoline and methylquinoline, a resin is formed, soluble in alcohol with red colour. If a mixture of 2 parts of methyl-*p*-toluquinoline iodide with 1 part of methyllepidine iodide, in aqueous solution, be heated with potash equivalent to one-half of the iodine present, dimethylmethylcyanineiodide of the formula

$$C_{22}H_{21}N_2I + H_2O$$

is obtained, crystallising in blue needles. The authors find that the colouring matter of Spalteholz has the formula $C_{23}H_{23}N_2I$, and not $C_{23}H_{25}N_2I$, the reaction taking place according to the equation

$$C_9H_7N_1C_2H_5I + C_{10}H_9N_1C_2H_5I = C_{23}H_{23}N_2I + 2H + HI.$$

This substance, isomeric, with diethylcyanine, is prepared from quinaldine-ethyliodide with 1·9 part quinoline-ethyliodide in 25 parts of alcohol, and the calculated quantity of potash gradually added, the mixture being heated on the water-bath. On distilling off a portion of the alcohol, the new compound crystallises out. A crystalline body can also be prepared in a similar way from ethylquinaldine alone.

Dimethylcyanine-iodide.—The two representatives of the colouring matter known as cyanine have been shown by the authors to be mixtures, the composition of the pure compound being expressed by the formula $C_{29}H_{35}N_2I$, formed according to the equation

$$C_9H_7N_1C_5H_{11}I + C_{10}H_9N_1C_5H_{11}I = C_{29}H_{35}N_2I + H_2 + HI.$$

The best yield is obtained by digesting amyliodide in alcoholic solution, with the corresponding bases—quinoline and lepidine—on the water-bath, the requisite amount of potash being added. On distilling off a portion of the alcohol, the colouring matter may be extracted from the residual resin by means of acetone. By heating amyl-lepidine iodide with an alkali, a red substance is formed, soluble in alcohol; but it has not been crystallised.—J. B. C.

Manufacture of Colouring Matter. Charles Denton Abel, London. From the Farbwerke vormals Meister Lucius and Brüning of Höchst-am-Main, Germany. Eng. Pat. 6311, April 12, 1884.

The object of this invention is to prepare violet and blue colouring matters of the rosaniline series by the action of perchlormethyl-formate upon tertiary aromatic amines in the presence of condensing agents. As a typical example, the inventors give the following method of preparing hexamethyl-violet:—25lb. of dimethylaniline are mixed with 5½lb. of perchlormethyl-formate, and 12lb. of anhydrous zinc chloride gradually added to the mixture. The violet gradually forms as a crystalline mass, which is freed from excess of zinc chloride by washing with water, and then purified in the usual way.—R. M.

A Process or Processes for Producing β-naphthotdisulphonic Acids, Separating the same and Obtaining Colouring Matters therefrom. Jasper Wetter, London. From the Leipziger Anilinfabrik, Beyer and Kegel, of Lindenau-Leipzig, Saxony. Eng. Pat. 7097, May 1, 1884.

Four parts of sulphuric acid of 66° Bé. are heated to 125-135° C., and one part β-naphthol is then quickly introduced, the temperature mentioned being maintained for four to five hours. The product is dissolved in three times its weight of water, caustic soda equal to half the weight of the acid employed is added, and the solution is then saturated with common salt. On cooling, a portion of the acid salts of the sulpho acids crystallises out, and the remainder is left in the solution. The crystalline portion is filtered off and washed with brine, and both this and the soluble portion may be directly employed for the production of azo colours, the latter giving the more yellow shades. The inventors give a list of the diazotised bases employed, and the colours obtained respectively from the soluble and the crystalline modifications of the disulpho acids.—R. M.

A Process or Processes for Separating the Different β-naphtholmonosulphonic Acids from a Mixture of the same, and for Obtaining Colouring Matters therefrom. Jasper Wetter, London. From the Leipziger Anilinfabrik, Beyer and Kegel, of Lindenau-Leipzig, Saxony. Eng. Pat. 7098, May 1, 1884.

According to this invention, β-naphthol when heated to 100° C. with the quantity of strong sulphuric acid, theoretically necessary to form a monosulphonic acid according to the process of H. E. Armstrong, gives rise to a mixture of two isomeric monosulphonic acids, which can be readily separated by treating the solution of the free acid or the sodium salt with common salt. Both the portion which separates out, and the soluble portion, can be directly employed for the preparation of azo colours. —R. M.

Estimation of Orthotoluidine and Paratoluidine, if present together in Mixtures, by means of the Specific Gravity. G. Lunge. Chem. Ind. **8**, 74.

The mixture of ortho- and paratoluidine forms a liquid at 15° C. as long as it does not contain more than 50 per cent. of paratoluidine. It is, therefore, easy to determine its specific gravity at 15° C. If it contains 60 per cent. of paratoluidine, the temperature at which the specific gravity is taken must be raised to 20° C. Beyond this percentage the author does not think his method available, owing to the different mixtures showing only very small differences in their specific gravities, and it being well-known that observations taken at temperatures artificially raised lose much in accuracy. For precise purposes the specific gravity must be found by means of a sensitive balance and picnometer, but for practical purposes the use of an accurate hydrometer is admissible. Absolutely indispensable is an accurate observance of the temperature, 1° C. more or less causing a difference

of 7 per cent. Furthermore, the mixture must not contain water or aniline or xylidine, and if so the former must be removed by means of fused potassium hydrate and successive distillation. If the temperature of observation is not exactly 15° C., the specific gravity found, must be adjusted for each ± 1° C.; if it be more than 1·0008 it must be corrected by ∓ 0·0008; if it be less than 1·0008 by ∓ 0·0007.

TABLE OF THE PERCENTAGE OF MIXTURES OF ORTHO- AND PARATOLUIDINE.

SPECIFIC GRAVITY TAKEN—

(a) at 15° C., and based upon water at 15° C.

Specific Gravity.	Orthotoluidine per cent.	Specific Gravity.	Orthotoluidine per cent.	Specific Gravity.	Orthotoluidine per cent.	Specific Gravity.	Orthotoluidine per cent.	Specific Gravity.	Orthotoluidine per cent.
1·0037	100	1·0024	88½	1·0011	78½	0·9998	68	0·9985	58
1·0036	99	1·0023	88	1·0010	77½	0·9997	67	0·9984	57½
1·0035	98	1·0022	87	1·0009	77	0·9996	66½	0·9983	56½
1·0034	97	1·0021	86½	1·0008	76	0·9995	65½	0·9982	56
1·0033	96	1·0020	86	1·0007	75	0·9994	65	0·9981	55
1·0032	95	1·0019	85	1·0006	74	0·9993	64	0·9980	54½
1·0031	94	1·0018	84½	1·0005	73	0·9992	63	0·9979	54
1·0030	93½	1·0017	83½	1·0004	72½	0·9991	62	0·9978	53
1·0029	92½	1·0016	82½	1·0003	72	0·9990	61½	0·9977	52½
1·0028	91½	1·0015	82	1·0002	71	0·9989	61	0·9976	51½
1·0027	91	1·0014	81	1·0001	70	0·9988	60	0·9975	51
1·0026	90	1·0013	80	1·000	69	0·9987	59	0·9974	50
1·0025	89½	1·0012	79½	0·9999	68½	0·9986	58½	...	...

(b) at 20° C. and based upon water at 15° C.

0·9939	50	0·9936	48	0·9933	46	0·9930	44	0·9927	41
0·9938	49½	0·9935	47½	0·9932	45	0·9929	43	0·9926	40
0·9937	48½	0·9934	46½	0·9931	44½	0·9928	42	...	...

—S. H.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Influence of Certain Processes in the Manufacture of Cotton Fabrics upon their Strength. Dingl. Polyt. J. **255**, 349.

SCHEURER (*Bulletin de Mulhouse*, 1883, p. 76) finds that water at a temperature of 150° has no marked tendering effect upon cotton, even when the action is continued for eight hours. At temperatures above 160° the tendering action of water is well-marked and considerable. Maintained in contact with air for one hour at a temperature of 170°, the fabric does not appear to suffer any diminution of strength. Grosseteste (*Ibid.* p. 65) contributes some experiments as to the temperatures to which fabrics attain during singeing. The fabric was saturated with a solution of an aniline salt, potassium ferricyanide and potassium chlorate, which at a temperature of 80° developed a green, at 100° a black, and between 120° and 130° a reddish-brown colour. With Tulpin's singeing machine the fabric became green; by passing three times through Blanche's apparatus with three flames, a uniform black was developed.

An extended series of experiments by Haebler upon the influence of the bleaching processes upon the strength of cotton fabrics is published in the *Mittheil. des Technologischen Gewerbe-Museums*, Section für Färberei, Vienna, 1884, p. 11. These experiments show that any tendering of a fabric cannot be ascribed to the action of chlorine or to any part of a properly conducted bleaching process. The following numbers, expressing the breaking weight in kilogrammes of a fabric after different stages of the bleaching process, may be adduced in proof of the foregoing statement:—

Stage of Process.	Breaking Load. Kilos.
Unsized	4·656
Sized	5·029
Singed	5·206
Boiled in lime, washed	4·694
Acidified with HCl, washed	4·664
Boiled in soda, washed	4·799
Treated with chlorine, washed	5·204
Acidified with H_2SO_4, washed	5·345
Dressed	6·423

A second series of experiments is devoted to the question of the tendering action of various mordants as follows:—

No. 1. Aluminium aceto-sulphate

$$Al_2(SO_4)_2(C_2H_3O_2)_2$$

with sodium phosphate.

No. 2. Sodium aluminate $Al_4Na_6O_9$ with ammonium chloride.

No. 3. Aluminium sulphocyanide $Al_2(CyS)_6$ with sodium phosphate.

No. 4. Pure acetate of alumina $Al_2(C_2H_3O_2)_6$.

No. 5. 140g. $FeSO_4$, 0·5l. H_2O, 55g. sodium acetate.

No. 6. Same as No. 5, but 110g. sodium acetate.

No. 7. Bistre: 100g. crystallised manganous chloride, 0·5l. of water, 55g. sodium acetate.

No. 8. Chromate of lead dye.

No. 9. Same as No. 8, but subsequently treated with lime water.

The breaking loads of portions of the same fabric treated with the above are here given:—

No. of Mordant.	Breaking Load. Kilos.
0	5·481
1	5·371
2	5·269
3	5·368
4	4·920
5	4·230
6	4·495
7	5·199
8	4·620
9	4·776

The conclusion to be drawn from the figures adduced is that cotton fabrics are weakened by the application of the mordants and compounds detailed above.—W. D. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Recent Progress in the Chemistry of Calico Printing. A Lecture delivered before the Verein z. Bef. der Gewerbefleisses, Berlin. O. N. Witt.

AFTER a general introduction, in which the author discusses the many-sided qualifications necessary to the discharge of the functions of a textile colourist, he proceeds to the treatment of the more important items in the recent progress of the art, viewed from the chemical standpoint. The processes of continuous steaming, and more particularly the apparatus invented by Mather & Platt, for instantaneous steaming, are exerting considerable influence upon the methods of development and fixation. The latter is of especial advantage in the development of aniline black, in the removal of the acetic acid present in the colour mixtures, as a preliminary to the longer exposure to steam in the ordinary apparatus, and in which the presence of the acid is objectionable, also in the fixation of many mordants, such as alkaline chrome. The author then refers to recent advances in the chemistry of cellulose, more especially to the researches of Witz and of Cross and Bevan, and the modifications of the fibre substance under oxidising influences, which they have brought to light (see this Journal, iii. 206 and 291). The power which cellulose has, of decomposing certain alkali-metal salts, and of appropriating the metallic oxide therefrom, is the basis of various novel mordanting processes, of which the application of a glycerine solution of the sodio-chromic oxide is the most important. The chrome mordant is most valuable for the fixation of cœrulein, alizarin blue, gallein, gallocyanin; also of the newly-discovered Victoria blue (presumably an α-naphthyltetramethylrosaniline). Researches in connection with the application of this colouring matter have led to the discovery of the elegant method of chrome mordanting, which consists in padding with a mixture of an alkaline bichromate, sodium thiosulphate, and magnesium acetate. At ordinary temperatures these salts do not react, but on steaming decomposition sets in, and the chromic oxide is fixed in the fibre.

Manganese mordants are employed for the production of various fast shades, by a subsequent dyeing process, which consists in boiling the mordanted fabric in a solution of a salt of an aromatic amine. As a result of the oxidising action of the oxide and its combination with the product of oxidation, a series of extremely fast shades may be obtained. In this way a black may be obtained from aniline sulphate; a red brown from naphthylamine sulphate. The result is susceptible of numerous modifications in its mode of application, some of which are mentioned by the author. He then proceeds to review the growth in the practice, which has now become general, of "preparing" cloth to be printed, by a treatment with Turkey-red oil. The efficacy of this mordant or prepare is entirely referable to the ricinoleic acid, which is its chief constituent. In connection with the subject of mordants, the author alludes to the experience of the dyer that one colouring matter may act as a mordant for another—*e.g.*, Millar's canarin for almost all the aniline colours; alizarin red for saffranin, alizarin violet for methyl violet. This has an important bearing on the practice of "topping" colours.

In his review of progress in the department of colouring matters, indigo is treated first. Mention is made of C. Kœchlin's method of discharge by means of a neutral chromate, printed topically, and afterwards decomposed in a bath of sulphuric acid, containing in addition oxalic, the latter serving to arrest the action of the chromic acid. By incorporating with the chromate a suitable mixture of albumen and a pigment, the latter is fixed by coagulation of the albumen at the same time that the indigo is discharged. By employing aluminium chlorate as a discharge, the fabric may be mordanted at the same time for alizarin, etc. Another process with the same object consists in padding with red prussiate and printing with sodium aluminate. The topical synthesis of indigo from nitrophenylpropiolic acid, the outcome of Bæyer's well-known researches, is a process that remains for the present very restricted in its application. The alkali-glucose reduction method of Schlieper and Baum is favourably noticed. The observation that the alkaline mixture used in this process destroys the adhesion of an alizarin lake to the cotton, is the basis of an indigo blue print upon a Turkey-red ground. It is only necessary to pass through sulphuric acid of 7° B., to complete the topical removal of the alizarin. Mention is also made of the method of reserving alizarin red by means of tartaric acid; also of reserving aniline black by means of the sulphocyanides. In speaking of the colouring matters which have been proposed as substitutes for indigo, the author mentions (1) indophenol. This body, which resembles indigo in giving a colourless reduction product, labours under the disadvantage of being sensitive towards acids, by which it is coloured red, and, in fact, decomposed; hence it has received only a limited application. In the printing of woollen goods, however, it is of more value in consequence of its peculiar property of acting, in the reduced state, as a discharge, upon the azo ponceaux. This is the basis of a method of producing very pretty effects in indophenol blue upon red grounds, and one which the author believes to be destined to a wide application. (2) The colouring matter, as yet uninvestigated, produced by the action of potassium bichromate upon logwood extract, in presence of the bisulphites. It gives, with acetate of chrome mordants, blue shades resembling indigo, but greyer in tone. They are, however, not very fast. In violet colouring matters the only recent introduction of importance is gallocyanine, a body of both basic and acid properties, produced by the action of nitrosodimethylaniline upon gallic acid. It can only be fixed by means of chrome mordants. It is extremely fast. In combination with berry liquor it gives indigo shades.

Cœrulein and gallein, colouring matters discovered by Bæyer, which remained for long unnoticed, are now being extensively used. The former is the basis of the new olive greens, which are extremely fast, and easy of production. The mordant is a mixture of acetate of chrome and sodium bisulphite. The indulins are now commonly used for the production of grey shades; they require a tannin mordant.

In red colouring matters, alizarin continues to be almost exclusively used. Great hopes are, however, entertained of the use of the new product azarin, the bisulphite compound of an azo colouring matter resulting from the action of β-naphthol upon didiazodioxysulphobenzide. A new feature, in this compound, is the presence of the SO_3H group, and the consequent absence of the tendency to sublimation. It is easily fixed by means of alumina mordants, and gives fast shades.

The author then mentions a group of colouring matters which appear to unite directly with cellulose,

and are, therefore, fixed without the intervention of a mordant; these are flavophenin, canarin, a product of oxidation of hydrosulphocyanic acid, and the so-called Congo red.

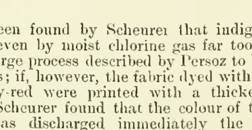
Lastly, of new yellows, the author mentions auramine, an ammonia derivative of tetramethyldiamidobenzophenone; and flavaniline, a base belonging to the quinoline series; and also a pigment yellow produced by steaming a mixture of cadmium nitrate and sodium thio-sulphate. —C. F. C.

Process for Bleaching Woven Fabrics. J. B. Thompson and J. P. Rückman (D. R. P., Cl. 8, No. 26,839, March 6, 1883). Dingl. Polyt. J. **252**, 392.

LINEN yarns and fabrics are first boiled for three hours in a dilute solution of potassium cyanide, washed, and again boiled in the cyanide. Cotton does not need this treatment unless it is more or less greasy, and even then the solution of cyanide must only be half as strong as for the linen, and only two hours' boiling is necessary. For the remainder of the bleaching process, the reader is referred to this Journal, vol. ii. 411, and vol. iii. 291. —E. G. C.

On the Discharge of Indigo-blue and Turkey-red by Electrolysis. F. Goppelsroeder. Dingl. Polyt. J. **253**, 431.

IT had been found by Scheurer that indigo-blue was attacked even by moist chlorine gas far too slowly for the discharge process described by Persoz to be a practical success; if, however, the fabric dyed with indigo-blue or Turkey-red were printed with a thickened alkali solution, Scheurer found that the colour of the parts so printed was discharged immediately the fabric was exposed to the action of chlorine gas. In the author's earlier experiments (*Ibid.* 253, pages 245 and 381, 1884) the discharge of these colours was effected by employing as electrolytes solutions of nitrates or chlorides, together or singly, and either neutral or acidified with sulphuric acid. On passing the electric current through a dyed



fabric printed or saturated with such solutions, the colour was discharged at the positive electrode, and in the case of neutral solutions being employed caustic potash or soda was set free at the negative electrode. The author was then led by Scheurer's discovery to employ as electrolyte a solution of sodium chloride rendered alkaline with either sodium or potassium hydrate, and found that the evolution of chlorine at the positive electrode was more vigorous than when the electrolyte was neutral or acid. If a fabric dyed indigo-blue or Turkey-red, saturated with a solution of sodium chloride or potassium nitrate, and caustic potash, be laid upon a platinum plate forming the negative electrode, and a platinum wire or plate forming the positive electrode, brought in contact with the upper surface, either colour is immediately discharged. In his experiments the author had recourse to the simple arrangement here figured. Upon the caoutchouc plate A the platinum plate B forming the negative electrode is laid, and upon this, the red or blue fabric C previously saturated with the electrolyte. Between B and C from eight to sixteen folds of similarly saturated white cloth may be interposed if desired. Upon the dyed fabric C the platinum plate D forming the positive electrode is placed, and glass plates E serve to protect the portion of the cloth not covered by D from the action of the gases evolved at the positive pole. This process may also be found of value for the development of various colours.—W. D. B.

H. Köchlin's Chrome Mordant with Colouring Matters. Dingl. Polyt. J. **255**, 447.

THE cloth is twice taken through a mordant consisting of one volume of chrome acetate 16°, three parts water, two parts NaOH solution 38° and $\frac{1}{16}$ part glycerine. The cloth is left several hours after mordanting and then thoroughly washed. The dyeing was made with the addition of different substances by way of comparative tests, such as alum, alum and chrome alum, and chrome alum alone, tin crystals, and glue. One part of the sample was steamed and the half of each soaped at 60°. The following results were obtained:—

1. The best effect produced by the addition of an equal weight of chrome alum. Bismarck brown, Coupier's grey, Victoria blue (this requires twenty times the weight of chrome alum), cochineal, eosin B., alkali blue.

2. The best effect produced by the addition of 25 per cent. of tin crystals. Ponceau 3 R., Bordeaux S., rose Bengal, rocceline, eosin, orange II., indigo-carmine, cochineal and Persian berries.

The colours in all cases are brightened by steaming. Those which under these conditions resist soaping are Bismarck brown, malachite green, Victoria blue, gallocyanine, cochineal, logwood, alizarin, nitro-alizarin, Persian berries, quercitron, cœruleine, eosin and rose Bengal. The following three colours give a negative result: Auramine, saffranine, alizarin blue. Ponceau 3 R. dyed with an equal weight of chrome alum on wool after steaming resists soaping at 75°.—J. B. C.

A New Red Discharge on Vat Blue. A. Scheurer. Dingl. Polyt. J. **255**, 452.

A MIXTURE of aluminium chloride and bichromate of potash thickened with starch is printed on the indigo-dyed cloth and then steamed for a minute in a Mather & Platt machine. It is washed, dyed in alizarin, and soaped. The red is somewhat dull, due probably to the products of decomposition of indigotine, which become fixed with the alizarin lake. This method resembles that of G. Saget, who proposed a mixture of aluminium chloride and finely-powdered manganese dioxide. —J. B. C.

Printing Blue Grounds upon Woollen Fabrics. O. Breuer. Dingl. Polyt. J. **255**, 534.

TO obtain, by printing, a uniform blue ground upon woollen fabrics, the author advises the addition to the colour of fifteen per cent. of ammonia. When Blue 5 B. is employed, the best results are obtained by decomposing this colouring matter in aqueous solution, with an acid, and redissolving the blue precipitate obtained, with ammonia. The printing colour is composed of two kilos. of precipitated blue dissolved in 350 grammes of ammonia, together with 500 grammes of glycerol, and 1100 grammes of dry gum senegal. The employment of ammonia is chiefly to be recommended when working with aniline colours; it exerts, however, a beneficial influence in conjunction with nearly all the artificial dyestuffs, even those—the ponceaus, for instance—upon which it has little specific action.—W. D. B.

The Fixing of Various Artificial Dyestuffs by Means of Ferro- or Ferricyanides. Dingl. Polyt. J. **256**, 42.

CERTAIN artificial dyestuffs being precipitated by prussiates, C. Reber (*Bulletin de Rouen*, 1884, 768) makes use of this property for fixing colours on vegetable fibres. For instance, if a solution of aniline violet be added to a solution of a yellow or red prussiate, a complete precipitation of the dyestuff takes place, probably as the ferro- or ferricyanide of methylrosaniline. The same is the case with fuchsin, methylene blue, etc. To carry out this process, the tissue is mordanted with a solution of prussiate. After drying, the dyestuff is printed on it, allowed to hang for 24 hours, steamed, washed, and soaped. Methylene blue and violet produce the darkest and fastest shades with red prussiate, whereas fuchsine yields the most beautiful colours with the yellow salt.

In order to employ the mordanting power of ferro- or ferricyanides for dyeing tissues previously printed upon, the author precipitated zinc ferro- and ferricyanide on the fibre, which compound, indeed, attracts the dyestuff forming permanent lakes. Thus prussiates may in certain cases take the place of tannin, a very desirable matter from an economical point of view.—S. H.

Manufacture of Antimonial Compounds suitable as Mordants in Dyeing and Printing. Wetter. Eng. Pat. 5887, April 3, 1884.

If alkalis, carbonates of the alkalis, or alkaline earths are allowed to act on sugar, gum, dextrin, or other carbohydrates, the products thus obtained give, with antimony, compounds which are soluble in water without decomposition. For instance, a solution of grape sugar is treated with a strongly alkaline substance until no further diminution of the free base takes place. The mass is then acidulated with a strong acid, and digested with antimonious oxide or any antimonial compound adapted to introduce into the liquid simultaneously with the necessary antimony a certain quantity of strong acid; such compounds are the trichloride, the sulphate, etc. In any case, however, that degree of acidity should be imparted to the liquid which causes the absorption of a maximum of antimony. The salts formed from the acid introduced into the liquid, and from the base contained in the same, are removed by filtration or crystallisation. The antimonial liquids resulting from these operations may be directly used in dyeing and printing textile materials, or they may be concentrated by cautious evaporation, or converted into a dry state.
—S. H.

Process of Bleaching Webs or Yarns of Vegetable Textile Materials. William Mather, Manchester. Eng. Pat. 471, January 13, 1885.

This invention consists in applying the operations referred to in the inventor's specification (2641, May 28, 1883), Thompson's specification (595, February 3, 1883), and Cross's specification (4984, Nov. 30, 1880), in combination, and as successive steps of one process.

What is claimed is "in bleaching, by a continuous process, webs or yarns of vegetable textile material, the combination of the operations of saturating with alkaline or equivalent solutions (*i.e.*, sulphite of soda, etc.), steaming, saturating with bleaching liquor, and exposing to the action of carbonic acid gas."—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

The Decomposition of Ammonium Sulphate by Sodium Sulphate under the Influence of Heat. G. Blattner. Dingl. Polyt. J. **255**, 253.

Carey and Hurter have patented a process for the preparation of ammonia from ammonium sulphate, which consists in the decomposition of that salt by means of sodium sulphate at a high temperature, the products of the reaction being free ammonia and acid sulphate of soda, which latter, mixed with common salt and heated, will give hydrochloric acid and neutral sodium sulphate. The author now records experiments he has made with the object of determining the degree of accuracy with which the reaction expressed thus:

$$(NH_4)_2SO_4 + Na_2SO_4 = 2NaHSO_4 + 2NH_3.$$

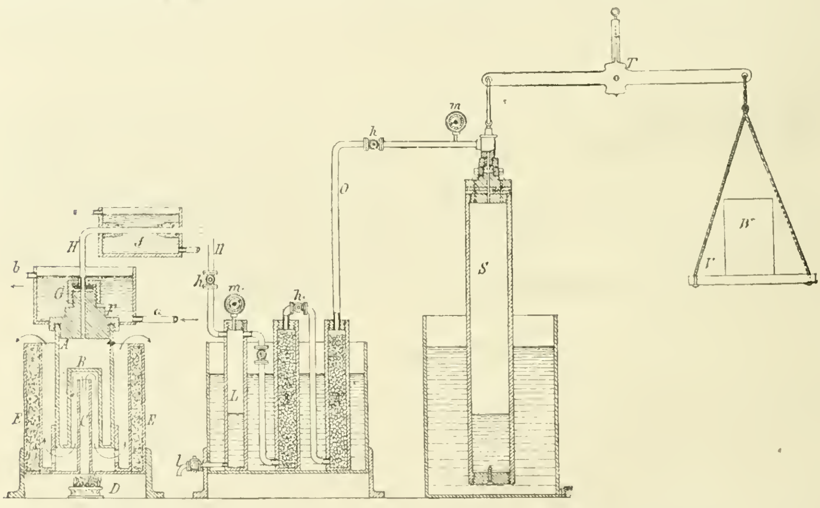
takes place. In the experiments recorded the substances in different proportions were heated to various temperatures in a retort connected with two conical flasks, containing dilute sulphuric acid, for the absorption of ammonia evolved, a stream of air being passed through at the end of each operation. The ammonia which remained in the body of the retort, and also as a sublimate of bisulphite upon the neck, was driven off by soda ley, and estimated. The amount of ammonia lost, probably due to decomposition and liberation of nitrogen, was determined by subtracting the total amount found from that employed in each experiment.

No.	Experimental Details.	Ammonia obtained. Parts per 100 of that taken.		
		Evolved as NH_3.	Remaining in the body of Retort and sublimed.	Lost.
1	10*g*. $(NH_4)_2SO_4$ in solution + 15*g*. Na_2SO_4	58·5	27·1	14·4
2	10*g*. ,, ,, 13*g*. ,,	69·4	14·2	16·4
3	10*g*. ,, ,, 13*g*. ,,	67·8	17·0	15·2
4	40*g*. ,, ,, 60*g*. ,,	65·7	20·6	13·7
5	20*g*. ,, ,, 50*g*. ,,	50·0	37·0	13·0
6	20*g*. ,, ,, 25*g*. ,, gradually heated till fused	56·3	25·5	18·2
7	20*g*. $(NH_4)_2SO_4$ ground up with 25*g*. Na_2SO_4, rapidly heated	66·6	16·4	17·0
8	Same as 7, but temperature not allowed to rise above 400°	15·4	60·6	24·0
9	20*g*. $(NH_4)_2SO_4$, 35*g*. Na_2SO_4, moistened with water and rapidly heated	58·5	23·0	18·5
10	20*g*. $(NH_4)_2SO_4$ in solution + 23*g*. Na_2SO_4, practically equivalent quantities	68·2	15·1	16·7
11	20*g*. $(NH_4)_2SO_4$, heated by itself	23·1	65·7	11·2
12	20*g*. $(NH_4)_2SO_4$ in solution + 25*g*. Na_2SO_4, temperature not allowed to exceed 400°	28·0	57·8	14·2

These figures show that the best results are obtained by employing approximately equivalent amounts of the substances, but that even then only between 65 and 70 per cent. of the ammonia present is obtained, the remaining 30 to 35 per cent. being partly retained, partly sublimed as bisulphite, and partly lost by decomposition. It may be found possible to prevent or at least lessen the loss of ammonia, by conducting the heating in presence of a current of water vapour.—W. D. B.

Apparatus for the Manufacture of Liquid Carbonic Acid. Dingl. Polyt. J. **256**, 36.

H. & J. F. BEINS, Groningen (Germ. Pat. 30,192, 1884), have patented the manufacture of liquid carbonic acid by heating sodium bicarbonate in an apparatus in which the carbonic acid evolved is liquefied by its own pressure. The cylindrical retort A (Fig. 1) is covered with a strong lid F, containing the outlet pipe for the carbonic acid. Its bottom is formed by a pipe B, closed at the top, and open at the lower end, thus exposing a large surface of the retort to the heat of the fire-gases, by compelling them to travel in the direction of the arrows in the diagram. A cooling arrangement protects the packing of the lid from getting destroyed. The carbonic acid given off travels through a cooling vessel J, where the steam is condensed and collects in the cylinder L. Thence it proceeds through two coke-towers, which serve to retain any organic matter, and lastly into the cylinder S, surrounded by cold water or ice. This cylinder is fastened to the beam of a scale for the purpose of filling it with any definite weight desired. The coke-towers stand in a vessel which can be filled with warm water in order to prevent the carbonic acid from being condensed in this part of the apparatus.—S. H.



On the Law of Solution. H. le Chatelier. Compt. Rend. **100**, 50 and 441.

IN the first of these communications, the author deduces from the principles of thermodynamics a relation between the solubility of salts, their heat of solution and the temperature. From this equation it is shown that the solubility of a salt which dissolves with absorption of heat, will increase with the temperature and inversely; whilst the solubility of a salt which dissolves with evolution of heat, will diminish with rise of temperature. —A. G. G.

On the Solution of Magnesium Carbonate by Carbonic Acid. R. Engler. Compt. Rend. **100**, 444.

BY estimating the solubility of magnesium carbonate in water at 12° C., charged with carbonic acid at various pressures, the author has obtained numbers from which he calculates the general equation $X^{\cdot 333} = ky$ (where y = quantity dissolved, X = pressure of CO_2 and k = a constant = ·03814);

$$\text{Hence } X = k^3y^3 \text{ or } y = \tfrac{1}{k}\sqrt[3]{X},$$

that is to say, the quantity dissolved at any fixed temperature is proportional to the cube root of the carbonic acid pressure.—A. G. G.

A Crystallised Hydrate of Phosphoric Acid. A. Joly. Compt. Rend. **100**, 447.

BY cooling the mother-liquor from the trihydrate, prismatic plates of a tetrahydrate ($P_2O_5 + 4H_2O$) crystallise out. This melts at 27° C., its heat of liquefaction being 3·64cals. It dissolves in less than 100pts. of water with absorption of heat, in more water with evolution of heat.—A. G. G.

Nitre-earth from Turkestan. N. Ljubawin. J. Russ. Chem. Ges. 617, 1884.

AN area of about four square kilometres, south-west of Fort Nukus, on the left bank of the Amu-Darjos, in the Khanate of Khiva, is covered with a layer of nitrate earth of the following composition:—Constituents soluble in water = 27·89; Ditto soluble in HCl = 17·14; CO_2 = 5·73; insoluble = 48·42. Total 99·18. The part soluble in water contains—

KNO_3	5·52	10·61 total nitrate.
$NaNO_3$	4·05	
$Mg(NO_3)_2$	1·04	
NaCl	12·90	
$CaSO_4$	3·25	
$MgSO_4$	0·66	

—J. T.

Improved Method of Producing Oxide of Strontium or of Barium. E. F. Trachsel, Middlesex. Eng. Pat. 6022, April 5, 1884.

SULPHATE of strontium or barium is reduced to sulphide by heating with carbonaceous substances. The sulphide

is then heated with oxide of iron or iron in a muffle in presence of air, and hydrate of strontium or barium is obtained from the product by extraction with water.
—G. H. B.

Improvements in the Method of Generating Carbonic Acid Gas, and in Apparatus therefor. J. Magnall and R. S. Lloyd, Middlesex. Eng. Pat. 6179, April 9, 1884.

CARBONIC acid is obtained by the action of dilute sulphuric acid on whiting, the reaction being maintained by agitation.—G. H. B.

Improvements in the Manufacture of Alumina. G. Rosenthal, London. Eng. Pat. 6290, April 12, 1884.

SULPHATE of alumina is heated with its equivalent of magnesium chloride, the reaction being assisted in the later stage by the application of superheated steam. Hydrochloric acid is evolved, and the residue, consisting of alumina, oxide of iron and magnesium sulphate, is lixiviated with water, and the oxide of iron is removed "by magnets."—G. H. B.

Improvements in the Manufacture of Carbonate of Soda. C. Wigg. Eng. Pat. 7525, May 10, 1884.

THIS invention is a combination of the Leblanc and the ammonia soda process, in order to obtain hydrochloric acid as well as carbonate of soda. The process can be resolved into the following stages: 1. Common salt is converted into sodium sulphate, the hydrochloric acid given off being condensed in the usual manner. 2. Sodium sulphate is mixed with a strong solution of ammonia or ammonium carbonate, and the temperature raised to that point at which the maximum of sodium sulphate enters into solution. The operation is performed under pressure in a closed vessel, provided with hollow rotating beaters. 3. The solution is allowed to cool while impurities settle out which can be removed. 4. Carbonic acid is passed into the solution under a pressure of from 15 to 40lb. until all carbonate of ammonia is converted into bicarbonate. Sodium bicarbonate is thereby precipitated and ammonium sulphate enters into solution. 5. Sodium bicarbonate is separated from ammonium sulphate by filtration, first through cloth and afterwards through gypsum, so as to ensure that the ammonium carbonate which has not entered into reaction with sodium sulphate shall be decomposed into ammonium sulphate. 6. The filtrate is evaporated to obtain ammonium sulphate for sale, or the solution is treated with brine and boiled down. By this means anhydrous sodium sulphate, free from iron, is precipitated and a solution of ammonium chloride is obtained, from which the ammonia can be liberated for re-use. 7. The sodium bicarbonate is roasted to convert it into carbonate of soda, carbonic acid being recovered at the same time.
—S. H.

Improvements in Apparatus for Disintegrating and Removing Impurities from Lump Salt. T. Higgin, Liverpool. Eng. Pat. 8266, May 27, 1884.

THE object of this invention is to remove without pulverising the "pan scale" and "sand scale," which the lumps contain, and which are harder than the salt. These can then be removed by sieving. The lump salt is disintegrated by hackling or tearing, as distinguished from crushing or pulverising. The specification contains a large number of drawings, giving the details of the machinery employed.—S. H.

Manufacture of Sulphate of Ammonia and Bye-products resulting from the Process. Kelly and Weigel. Eng. Pat. 8680, June 6, 1884.

KIESERITE solution is mixed with common salt and the mixture subjected to a low temperature, when a double decomposition takes place producing sodium sulphate, which crystallises out, and magnesium chloride, which remains in solution. Ammonia is then passed along with carbonic acid through the solution of sulphate of soda, thus producing sodium bicarbonate and ammonium sulphate. During this reaction the vessels are kept cool. The bicarbonate is allowed to settle and removed in the solid condition, whereas the solution of ammonium sulphate, which also contains small quantities of sodium bicarbonate, sodium sulphate, ammonium hydrate and carbonate, is subjected to distillation, in order to drive off the volatile ammonium compounds. At the same time, the small quantity of sodium bicarbonate is converted into sulphate of soda, which can be removed by crystallisation. Ammonium sulphate is then obtained from the residual solution by evaporation.—S. H.

Improvements in Purifying Sulphuric and Sulphurous Acids and their Salts. J. Meikle. Eng. Pat. 11,866, September 2, 1884.

THIS invention consists in passing sulphuretted hydrogen through the acid or a solution of their salts. The effect is to form a precipitate of sulphides of arsenic or other metals, and this precipitate, which is separated by filtration, may be utilised by burning so as to yield sulphurous acid. Sulphuric acid derived from pyrites and purified by this process is well suited for making sulphate of ammonia of good quality.—S. H.

Improvements in the Manufacture of Chlorine. Ernest Solvay, Brussels. Eng. Pat. 7258, January 15, 1885.

THESE improvements relate to the process referred to in Patent No. 77, January 8, 1877; No. 838, January 25, 1880; and No. 839, January 25, 1880. 1. To prevent the introduction of carbonic acid into the chlorine, the silicious or aluminous substances used are treated with an acid to decompose carbonates, and ignited (with nitrate of soda, if necessary) to remove organic carbon. 2. When the mixture to be decomposed contains chloride of calcium corresponding with the required theoretical quantity of silica and alumina, the matter agglomerates and the apparatus works with difficulty. The addition of more silica or alumina gives the required infusibility, but the material is no longer suitable for the manufacture of cement. This difficulty is obviated by the introduction of a sufficient quantity of the residuum of a previous operation. 3. The air used is purified from carbonic acid and moisture by passing through a series of suitable absorbing vessels.
—A. R. D.

Improvements in the Manufacture of Chlorine and Chloride of Lime. Ernest Solvay, Brussels. Eng. Pat. 7259, January 16, 1885.

THESE improvements relate to the same process as the preceding. To enable the apparatus to resist the action of chlorine the iron or cast-iron is covered with preservative coatings of certain mixtures of soda, clay, and vitrifiable products. To this enamel is sometimes added a fireproof coating which adheres to the metal through the intermediary of the vitrified enamel. The absorption by lime is effected by placing the lime in a layer of suitable thickness on beds of porous mineral matters, such as pebbles, or mineral fabrics, such as asbestos cloth, and causing the diluted chlorine to pass downwards through the same. If the gases pass upwards, channels are soon formed and irregularity ensues.—A. R. D.

Improvements in the Manufacture of Hydrochloric Acid. Ernest Solvay, Brussels. Eng. Pat. 7260, January 16, 1885.

THIS invention relates to the process of decomposing calcium chloride with aqueous vapour in the presence of silica or silicious substances. When this mixture is made in the theoretical proportions the matter agglomerates and the apparatus works with difficulty. The addition of more silica and alumina, while promoting the infusibility of the mixture, renders it unsuitable for the manufacture of cement. The difficulty is obviated, however, by introducing a sufficient quantity of the residuum of a previous operation. Silicious clays, infusorial silica, fossil flour, etc., as well as precipitated silica, are much to be preferred to sand in the above operation.—A. R. D.

Improvements in obtaining Solid Caustic Soda from Fused Caustic Soda. W. Weldon. From A. R. Pechiney et Cie, Salindres. Eng. Pat. 2478, February 24, 1885.

This invention consists in a method of obtaining caustic soda in films or sheets, capable of being readily converted into powdered caustic soda. Fused caustic soda is brought into contact with the exterior surface of a revolving hollow cylinder, the heat being carried off by water passed through the interior of the cylinder. In Figs. 1 and 2, A is a hollow cylinder turning on hollow

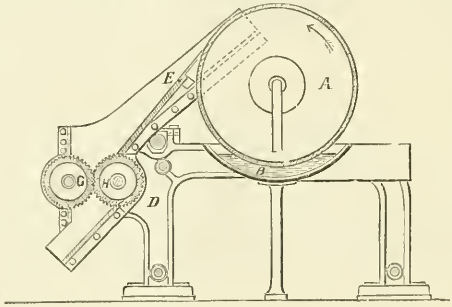


Fig. 1.

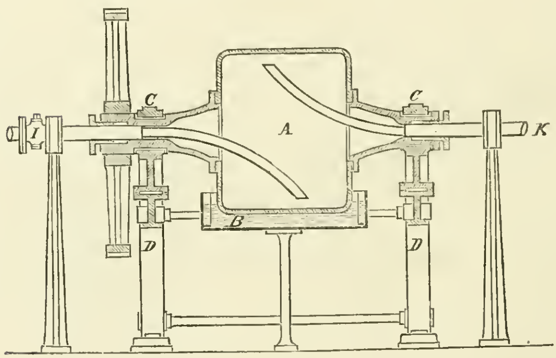


Fig. 2.

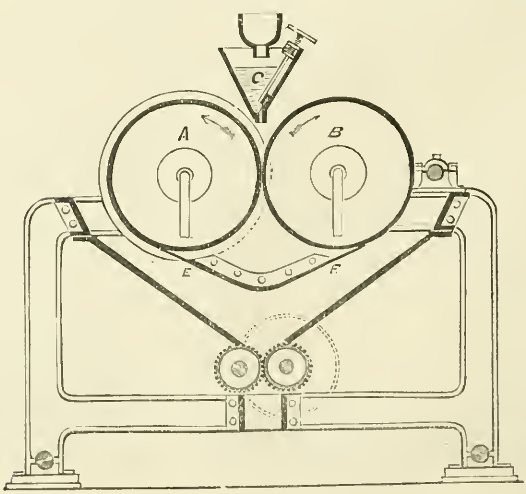


Fig. 3.

axles CC. Water is admitted into A, passing out near the top by the pipe K. Below the cylinder is a small trough B, into which fused caustic soda is fed. As the cylinder A revolves, it dips a little below the surface of the caustic soda and emerges coated with a film of solid

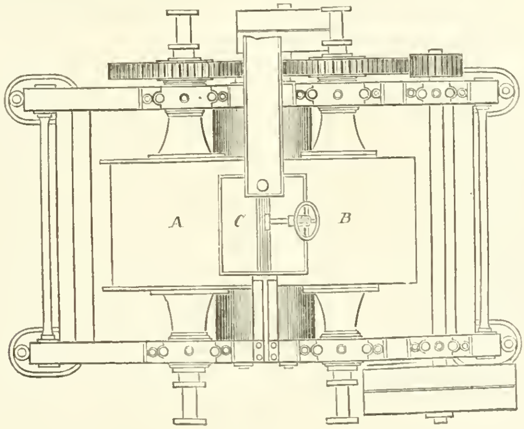


FIG. 4.

caustic soda, which on reaching the scraper E is detached from the cylinder and falls into a conduit, from which it falls between the toothed rollers G and H, which crush it into small fragments. Figs. 3 and 4 represent another disposition of apparatus for the same purpose. There are two hollow cylinders A and B turning in opposite directions. At each extremity of the cylinder A is a flange which overlaps the corresponding extremity of the cylinder B. C is a hopper into which the fused caustic soda is charged. It is provided with a slit at the bottom and a contrivance to regulate the feed at will. The two cylinders are kept cooled by water continually passing through them. E and F are scrapers which detach the solid caustic soda and deliver it between the two toothed rollers.—S. H.

The Protection of Nitrate of Ammonia from Deliquescence. W. R. Lake, London. Eng. Pat. 1868, Feb. 10, 1885.

NITRATE of ammonia, used in the manufacture of explosive compounds, is protected from deliquescence by mixing it in a granulated condition with bye-products from the petroleum distillation. It then resembles moist brown sugar, and is not liable to become lumpy or solid.—S. H.

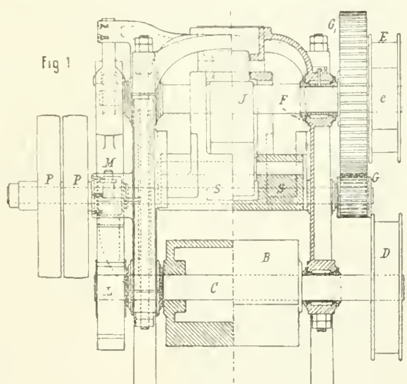
VIII.—GLASS, POTTERY, AND EARTHENWARE.

Recent Improvements in the Manufacture of Earthenware. Dingl. Polyt. J. **255**, 505.

IMPROVEMENTS in Schmerber's press for the manufacture of fluted tiles have been made by Boulet, Lacroix & Company. In Figs. 1 and 2 are shown the arrangements now adopted. The prism B, upon the five sides of which the lower moulds are fixed, revolves upon the axis C, motion being transmitted from P by S, G, G_1, E and D, the two latter being pulley wheels in connection. The revolution of B is regulated by the ratchet wheel L, and catch M. When M is lifted up by means of the cam N upon the spindle F, the prism is free to revolve, but the catch soon falls again, and when the next notch of L is brought beneath M, the prism is brought to rest. By this means the moulds upon B and S are brought to exact and certain correspondence; this was not the case in the original machine. The slide S, which carries the upper mould, is actuated by the cam J. The moulds are of plaster of Paris, and are fixed in iron boxes in the usual manner. With 1 horse-power, 55 or 60 revolutions of the driving wheel P, and two men serving, 500 fluted tiles can be turned out per hour by this machine.

In Vincent's fluted tile press, shown in Figs. 3, 4 and 5, the mechanism for working the upper mould-carrier P^1 is placed below the revolving five-sided prism, P carrying

Fig 1



the lower moulds. By the introduction of steam into the interior of M_1 and P the moulds are heated that the tiles may have less tendency to adhere. The flat plates of clay to be fluted are carried on to the lower mould by the endless band G; when the pressing is accomplished a frame A is laid upon the tile and there held by catches C, until by the revolution of P the tile attains a horizon-

tal position; on releasing the catches the tile falls off. This arrangement for retaining the tile upon the mould forms the subject of the patent (Ger. Pat. 29,514, May 29, 1884). Magowan and Bassett (Ger. Pat. 28,527, December 19, 1883) adopt the plan of warming the moulds for dishes and such ware, in order to facilitate

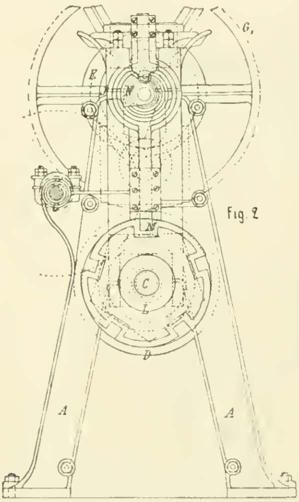


Fig. 2

the removal of the moulded clay, interposing thin sheets of metal or caoutchouc between the mould and the clay. Thus in moulding plates, the lower mould is covered with a thin sheet of metal, by means of which the moulded clay is easily removed from the mould; between the clay and the upper mould is a thin sheet of caoutchouc which can be readily detached from the clay plate after pressing. The Brothers Netzch (Ger. Pat. 28,651, February 5, 1884) have devised the following process for placing clay sheets with rapidity and accuracy upon the mould or wheel for further manipulation. The sheet of clay is first prepared upon a wheel covered with leather, the edge of which is turned down, as shown in Fig. 6, and held firmly between two rings *b*. The inner ring firmly embraces the circumference of the wheel. The clay which projects beyond the edge of *a* is cut off with wire, and the disc lifted from off the wheel by its rings.

The counterpoise M is adjusted to maintain S in its highest position until it is required to depress G, which

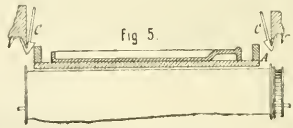


Fig 5.

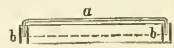


Fig. 6.

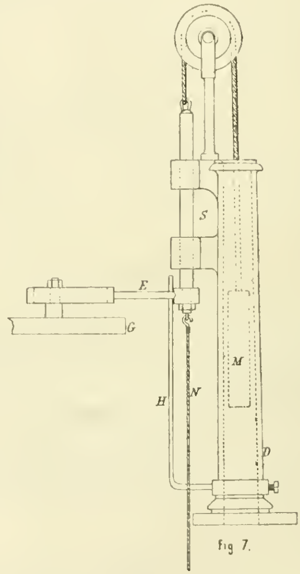


Fig 7.

is effected by the cord N and a foot lever. The ring of the leather disc described above is now passed over C,

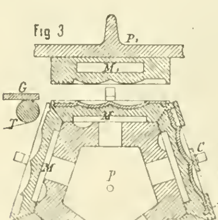


Fig 3

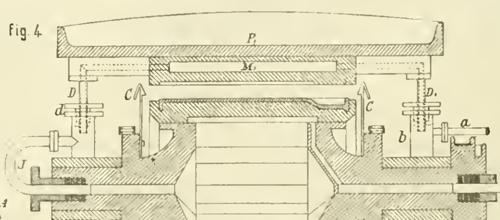


Fig. 4

A second workman, who has to carry the work a further stage, has, near his wheel, the apparatus shown in Fig. 7. A rod S, movable vertically in two guides shown, carries at its lower end an arm E with disc G attached.

which is fixed in such position in respect to E that by turning the latter round upon S until E is in contact with H, the centres of G and the wheel are in vertical line. G is now brought down to the wheel, upon which,

on rising, it leaves the clay sheet and disc. The wheel being set in motion, the leather is loosened by a spatula, removed, and the clay manipulated as usual. By means of the machine patented by Gregg (Ger. Pat. 29,693, May 30, 1884) it is intended not only to measure off accurately the requisite quantity of clay for each tile, but also to distribute coloured clay or glazing flux over the two opposite surfaces of each tile.—W. D. B.

Solubility of Glass. E. Bohlig. Zeits. Anal. Chem. **23**, 518.

THE author found that a number of new flasks ordered for laboratory use gave up to 100cc. of boiling water sufficient alkali, in the form of silicate of soda, to neutralise $\frac{1}{10}$cc. of oxalic acid every two seconds. The solubility in this particular case appears to be quite exceptional.—J. B. C.

Improvements in the Manufacture of White Opaque, Opalescend or Semi-transparent Glass and Enamel. John Henry Johnson. From Adolf Zeodesco, Müigeln, Saxony. Eng. Pat. 6899, April 28, 1884.

THE inventor substitutes for phosphate of lime, cryolite-felspar or fluor-spar, or the double fluoride of aluminium and alkali in conjunction with the usual ingredients for producing opacity in glass—an alkaline fluoride either with or without the conjoint use of a substance containing alumina. He regards as an important point the advantage of this mixture as a substance of easy production, either by adding to fluoric acid the requisite quantity of an alkali or its carbonate, taking care to have an excess of alkali. Or by treating the aluminate of an alkali with fluoric acid till all the alkali is fixed so that hydrate of alumina is precipitated, and after calcination a mixture of alkaline fluoride and alumina will result. Although mentioning the use of alumina and alkaline fluoride for the production of opalescence in glass or enamel, the inventor claims only the use of the fluoride of an alkali in conjunction with materials employed for producing such result.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Adulteration of Portland Cement. R. and W. Fresenius Zeits. Anal. Chem. **24**, 66-71.

THE name Portland cement should be confined to the product obtained by heating together lime and clay in definite proportions and then finely powered. When this product is mixed with more than 2 per cent. of foreign matters, such as gypsum, the authors contend that the name "Portland cement," if applied to the mixture, is fraudulent. Whether a cheap substance, without any influence on the durability, etc., of the cement is used as an adulterant or a substance added to improve the quality, the name "Portland cement" cannot rightly be employed for the mixture. The authors consider that the nomenclature needs revision and seek the co-operation of cement manufacturers for this purpose. Their tests furnish a ready means of distinguishing the pure article and substitutes or mixtures (*Zeit. Anal. Chem.* 23, 175).—S. R.

An Improved Process and Apparatus for Treating Wood, chiefly Designed for the Preservation of Railway Sleepers. W. R. Lake, London. From E. L. Collings and C. F. Pike, U.S.A. Eng. Pat. 833, Jan. 20, 1885.

THIS invention consists in the treatment of wood by first steaming it, then drying it by radiated heat and subjecting it to the action of an antiseptic material vaporised by radiated heat. The apparatus and the mode of procedure are described in detail in the specification.
—D. B.

X.—METALLURGY, MINING, Etc.

Process for the Extraction of Cobalt and Manganese. Herrenschmidt and Constable. Dingl. Polyt. J **252**, 392.

ORES containing cobalt or manganese are pulverised and boiled for half-an-hour with water and sufficient ferrous sulphate to convert the oxides present into cobaltous and manganous sulphates, which go into solution; this is decanted from the residue, the proto-salts being afterwards oxidised into per-salts.—E. G. C.

On the Preparation of Aluminium. Dingl. Polyt. J. **253**, 426.

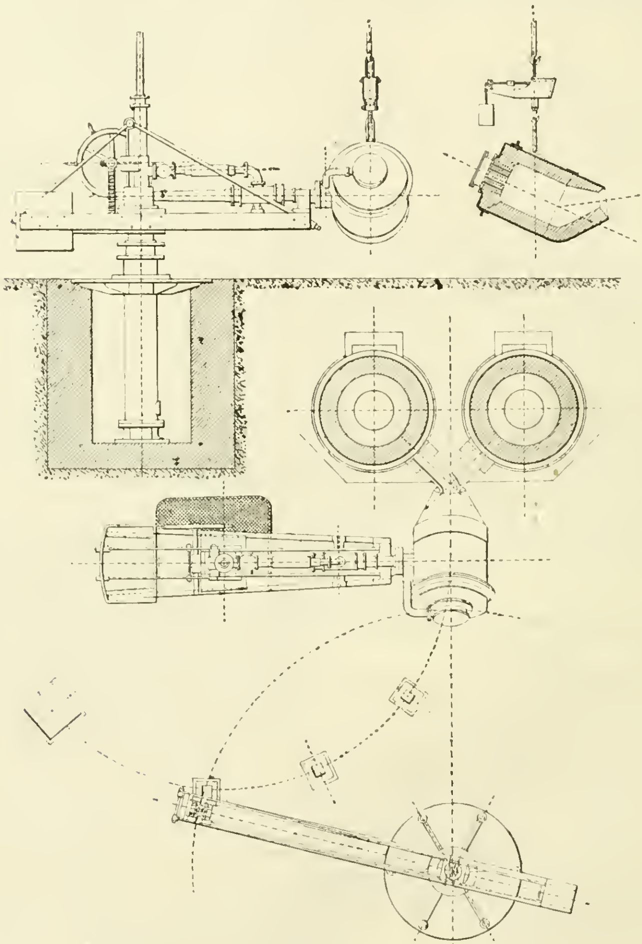
H. D. GADSDEN, London (Ger. Pat. 27,572, August 8, 1883), mixes corundum, bauxite, and the like with about 10 per cent. of sodium or potassium fluoride and the same amount of calcium fluoride. The whole is calcined, ground to a powder, mixed with 10 per cent. of wood-charcoal or carbonaceous matter, balled and transferred to a retort or muffle, in which it is burnt. The spongy mass obtained is removed to a second retort, and exposed to the action of a stream of chlorine gas; the aluminium chloride which is formed, is distilled into a receiver, having been, if necessary, previously freed from iron by leading the vapour through a tube filled with iron turnings. To effect the reduction to aluminium of the chloride so obtained, the latter is transferred to a fire-clay retort, connected by a leading tube with a second similar retort, in which a mixture of 20 parts of sodium carbonate and 16 parts of charcoal, or an equivalent amount of other carbonaceous matter, and 5 parts of lime or chalk, is heated to such a temperature that sodium vapour distils over into the aluminium chloride, reducing the latter to the metallic state. The aluminium collects at the bottom of the retort, and may be drawn off and cast into bars.—W. D. B.

Progress in Metallurgy. Dingl. Polyt. J. **255**, 375.

Siemens-Martin Process.—J. Riley read an important paper on the arrangement of plant, at the Chester meeting of the Iron and Steel Institute (see *Journ. Iron and Steel Inst.* ii. 1884, pp. 443-452). With a modern 12-ton Siemens furnace, "good work" requires that 140-150 tons of ingots shall be made weekly per furnace. In 1880 experiments were made with a basic lining, but great difficulty was caused by fluxing at the lines of division of the basic and acid material, and the experiments were stopped. At Blochairn a row of twelve 15-ton furnaces was erected, and the arrangement finally adopted for casting was as follows:—The furnaces were marked A to M, the last one being capable of holding 25 tons, the others being 15-ton furnaces. On a railway in front of, and parallel to, the furnaces runs a small locomotive which moves a special carriage conveying a ladle for the steel, and a mould for the slag. A 20-ton hydraulic lift is erected between furnaces E and F, and over the railway. In front of this is a 20-ton casting crane which does not lift, but turns on its axis, and has a ram for turning over the casting ladle after each cast. This crane is placed in the centre of a semi-circular casting pit, 40ft. in diameter and 3 feet deep. Around the casting pit are three ingot cranes, and between the cranes are two sets of soaking pits, each with six cells of differing capacity for ingots of 30 or 60cwt. each. The two outer cranes set the moulds in the pit, strip the ingots and deposit them in the soaking pits. The centre crane lifts the ingots from the soaking pit and places them vertically on the tipping carriage at the end of the feed rollers of the cogging-mill. A hydraulic ram tips the ingot easily and without shock on to the feed-rollers of the mill. When a furnace is ready for tapping, the contents are run into the ladle on the carriage, the whole of the steel and slag being run into it, while the latter overflows into the slag mould. Being brought under the lift the ladle is raised and tipped automatically, so that the steel flows into the casting ladle. The charge is now transferred to the moulds in

the usual manner. The time occupied in tapping the furnace, transferring and casting is fourteen to fifteen minutes. After standing twenty minutes the ingots are stripped and placed in the soaking pits, where they remain about fifty-five minutes; altogether the slab is finished in about ninety-five minutes, five minutes going to cogging and shearing.

to bind it. The furnace so prepared was charged with freshly burnt lime, then with pig-iron, and lastly with iron and steel scrap. The amount of lime was $\frac{1}{10}$ to $\frac{1}{20}$ of the pig charged. In three to four hours the pig is melted, and a liquid slag can be run off. In three hours more the scrap is melted and more slag is run off. If necessary the slag may be thickened by the addition of



Basic Process in Siemens-Martin Furnace.—T. Gillot read a paper before the American Institute of Civil Engineers. The hearth was formed of lime 58 parts, magnesia 24, silica eight, alumina and iron oxide 10 parts. This material was burnt at a strong white heat, pulverised, and mixed with hot tar. The mass is at once stamped in position with red-hot stamps. Between the basic mass and the acid wall is inserted a layer of magnesia and bauxite. After 72 hours' firing, a layer of freshly burnt dolomite was spread over the hearth. About 10 per cent. of refractory stone is mixed with the dolomite lime or iron ore, according as the proportion of pig to scrap is large or small. After the boiling period, a test is taken, and if the result is satisfactory the whole of the slag is run off. Five per cent. of hæmatite pig is now added, and a violent boiling results for 15 minutes; after 15-30 minutes more the charge is tapped off. The hearth is repaired, and in one to four hours is ready for another charge.

Bessemer Converters.—P. Lamberty (Ger. Pat. 29,571, April 30, 1884) proposes to make the bearing ring hollow, to serve as air chest, and from it the air is

passed obliquely downwards through the side of the vessel.

W. Hupfeld, discussing the same subject, remarks that for rolled articles which do not require to be further treated, such as rail, a moderate amount of silicon up to 0·5 per cent. is not injurious in presence of an equal amount of manganese; but for articles richer in carbon, or which have to bear reheating, the silicon should be reduced as much as possible. Although a metal can be produced in large vessels with 0·12-0·20 per cent. carbon, 0·03-0·06 silicon, 0·25-0·4 manganese, 0·035-0·05 phosphorus, and 0·01-0·03 sulphur with the greatest certainty, still a method of further reducing the silicon in Bessemer metal is desirable. According to F. Müller the metallic bath only reduces silicon from a rich silicious slag at a high temperature. Hence, according to Hupfeld's view the lower temperature of a small Bessemer apparatus offers a partial solution of the problem. Successful results have been obtained at Prävali as was previously the case at Avesta. *P. v. Tunner* writes on the subject, but concludes that large blows must prove most economical.—J. T.

Combination of Carbon with Iron. Walther Hempel. Ber. **18**, 998.

It has been shown that iron can take up carbon from its gaseous compounds, such as carbonic oxide, cyanogen, and hydrocarbons, at temperatures only moderately high.

The author describes experiments which prove that a much higher temperature is required for absorption of solid carbon by iron if oxygen is excluded. This temperature varies with the modification of carbon used, and is lowest for diamond. The lowest temperature at which a plate of wrought iron absorbs carbon when covered with powdered diamond and heated in a stream of nitrogen is 1160° C., with pure charcoal this temperature is between 1385° and 1420° C. If iron is fused in the electric arc in an atmosphere of nitrogen it is converted into white iron.—A. G. G.

Improvements in the Manufacture of Metallic Compounds or Alloys. John Radford, Shipley, Yorkshire. Eng. Pat. 3233, February 13, 1884.

The improvement consists in the addition of chromium, either as such or as chrome iron or chrome steel, to bronze, brass, gun metal, white metals, or similar alloys. Nickel and cobalt are sometimes employed in addition to the chromium.—W. G. M.

Improvements in the Collection and Treatment of Flue-dust. H. Barclay and R. Simpson, Cumberland. Eng. Pat. 3498, February 18, 1884.

The deposition of the flue-dust from furnace gases is assisted by means of trays placed in the flues, and also by washing the gases with water. Alkaline salts are obtained from this dust by extraction with water and evaporation of the solution, and the residue may be used as a raw material for iron smelting.—G. H. B.

Improvements in Electro-plating Chromium Alloys. Thomas Slater, Bayswater. Eng. Pat. 5245, March 21, 1884.

The anodes of chromium alloy may be prepared by heating chromium compounds with charcoal in a closed crucible, and pouring upon the reduced mass 2½ parts of fused copper, and, subsequently, 1 to 1½ parts of molten tin; and then granulating, re-fusing, and casting in moulds of the desired shape. These are next used as anodes in a solution, preferably made by dissolving 1lb. of potassium cyanide and a like quantity of ammonium carbonate in a gallon of water, heated to 150° F., until a good deposit of alloy is formed upon the cathode, when the bath is ready for use. To finish the plated articles, they are coloured with a bath of chloride of tin (6 to 8 parts), chloride of copper (20 to 25 parts), bichromate of ammonia (10 to 15 parts), chloride of platinum (6 to 12 parts), cyanide of potassium (25 to 30 parts), and water (101 to 110 parts). A very moderate current only is necessary.—W. G. M.

Improvements in Extracting Gold and other Metals by Amalgamation, and Apparatus therefor. Ewald Fischer, Silesia, and Max William Weber, London. Eng. Pat. 5834, April 2, 1884.

According to this invention, ground or crushed ore mixed with water is stirred with mercury for a sufficient time to effect the amalgamation with it of the precious metals. The ore is then discharged, leaving part of the metal in the mercury, but carrying away with it a considerable amount of the mercury and amalgam in a finely divided condition. These tailings are then subjected to the action of an electric current at the same time that they are stirred or agitated, which effects a complete condensation of the metallic and amalgam particles. Suitable apparatus is described in the specification, and four drawings.—B.

Improvements in the Purification of Iron Ores and of Iron by the Basic Process. Wm. Ph. Thompson, Liverpool. From R. Sohliwa, Dortmund, Germany. Eng. Pat. 7404, May 8, 1884.

The invention refers to a method of eliminating sulphur and silicon from iron ores and iron whilst under treatment by the Thomas and Gilchrist process.

The bottom of a converter lined with magnesia and lime is covered with a mixture consisting of two parts of pulverised anhydrous carbonate of soda, and one part of pulverised carbonate of lime. When the blow has begun a sufficient quantity of the mixture is added to make the total weight of the mixture present to be in the proportion of one part of carbonate of soda and one-half part of carbonate of lime to two parts of the silicon present in the whole charge.

After formation of the silicates, the fluid slag is carefully removed, and for every three parts of sulphur in the crude iron, ten parts of carbonate of soda (without lime) are added to the molten metal, the blowing being continued until desulphurisation has been effected. The slag now formed is again carefully removed, and another ten parts of carbonate of soda (without lime) are added for every three parts of phosphorus contained in the crude metal, and the blow finished. The slag resulting from this final blow is added to that first obtained, and is afterwards treated as phosphatic slag containing phosphoric acid soluble in water.—B.

Improvements in the Manufacture of Spongy Iron, and in Apparatus employed therefor. Gustav Bischof, London. Eng. Pat. 8093, May 22, 1884.

The inventor treats iron ores or products containing iron in an oxidised state with hydrogen and carbonic oxide and anhydride in such a way as to heat and deoxidise them at one operation.

For this purpose steam is decomposed over incandescent coke, the resulting gases consisting essentially of hydrogen, carbonic oxide, and carbonic anhydride, and some free steam. The latter having been removed by cooling and condensation, the remaining gases are strongly heated and passed into the lower part of an inclined retort into the upper end of which the ore is fed, and allowed gradually to descend to the lower part. Here it comes in contact with the mixed gases, and is reduced to the metallic state by the hydrogen contained in them. The spongy iron so obtained is discharged into a receptacle and cooled before exposure to the air.

The remaining gases which pass upwards through the inclined retort, deprived of the greater part of their hydrogen, but still combustible, are met by a current of air, and burned inside the retort. In this way they heat the oxide of iron preliminarily to its contact with hydrogen, and make any external heating in most cases unnecessary. The process is carried on at a low red heat.—B.

Improvements in the treatment of the Oxides of Iron obtained either from Iron Pyrites or from other sources, so as to render them more suitable for employment in the Blast or other Furnace. James Mason. Eng. Pat. 8679, June 6, 1884.

The inventor proposes to remedy the difficulty hitherto found in the use, for blast and other furnaces, of iron oxide in a state of dust or minute particles. He mixes such oxides with a considerable amount of water, and places the wet mass, whether in lumps or moulded, upon a bed of fuel in a kiln, filling in the interstices and covering up with fuel. After the firing has commenced further layers of the mass and fuel are gradually added, and the process continued until the kiln is filled, when the burning is completed, and the mass allowed to cool. The small particles will then be found to have been strongly agglutinated by the heat, and the mass be fit for use as required. The specification is accompanied by a sheet of drawings, showing a kiln arranged for the purposes of the patent.—B.

An Improved Method of Amalgamating or Separating Metals from their Ores. Jonathan Aldous Mays, London. Eng. Pat. 8295, May 27, 1884.

In this process the mixture of ore and water is fed in thin streams beneath the surface of flowing mercury, by means of a series of nozzles, themselves stationary or moving in a direction opposite to that of the mercury. This is effected by confining the mercury in a circular metallic pan, in which it rotates, either through the rotation of the pan itself or by the action of internally revolving arms. The nozzles are fed through an annular chamber, connected with a supply tube of sufficient height to allow of the contained mixture of ore and water overcoming the pressure of the column of mercury in the pan.—W. G. M.

An Improved Process of Preparing or Treating Copper. Alex. Melville Clark, Middlesex. From Wunibald Braun, Frankfort-on-the-Maine, per Wirth & Co. Eng. Pat. 8355, May 28, 1884.

A current of hydrochloric acid gas is passed through the melted copper, and thus all metallic oxides (including that of copper), and all metals, which are capable of decomposing the gas, are removed as volatile chlorides. A very pure metal of low electrical resistance is obtained, and may be cast free from blowholes in moulds filled with any neutral gas, such as hydrochloric or carbonic acid, or lighting gas. The process of poling copper may be partially or entirely superseded by this process.—W. G. M.

Process for the Reduction of Iron Ores and Production of Iron and Steel. Fredk. Siemens, Westminster, and Joseph G. Gordon. Eng. Pat. 8490, May 31, 1884.

Finely pulverised iron ore, intimately mixed with carbonaceous and fluxing materials, is introduced (in the form of bricks or enclosed in iron vessels) into an open hearth regenerative furnace of the Fredk. Siemens type (Eng. Pat. 5677, 1883). There it is reduced, and the metal and slag fused as fast as they are formed, solely by the radiant heat of, and not by direct contact with, the flame. The fluid metal and slag separate by gravity.—W. G. M.

Improvements in Processes for obtaining Copper, Silver, and Gold from Copper Matte or Regulus. Wm. Aristides Vérel and Peter Stewart, Tharsis Sulphur and Copper Co., Glasgow. Eng. Pat. 8562, June 4, 1884.

This patent is intended to render the ordinary wet process available for the treatment of regulus. The matte is crushed fine and mixed with its own weight of sodium chloride, and then, to the extent of 5 or 6 per cent., with the usual mixture of burnt pyrites and salt; the whole mass is then calcined, and subsequently treated as in the usual wet process.—W. G. M.

Improvements in obtaining Gold and Silver from Auriferous and Argentiferous Sulphide of Antimony Ores. Jas. Simpson and Edward Wm. Parnell, Liverpool. Eng. Pat. 13,074, October 2, 1884.

In the treatment of sulphide of antimony ores with solution of the sulphide in alkali or alkaline sulphide as by Patents 11,827 and 11,828, 1884, the whole of the silver, and the greater part of the gold, remain in the residue, a small portion only of the gold passing into the solution as sulphide. To obtain the precious metals from the residue, the sulphur is to be removed by roasting, or by any wet method; and the desulphurised mass treated by amalgamation, chlorination, or any other suitable process. The gold is recovered from the sulphide solution by precipitating a small quantity ($2\frac{1}{2}$%) of the antimony sulphide by acid or other means, which quantity will carry with it the whole of the gold; the latter may then be removed by any known process.
—W. G. M.

Depositing Magnesium and its Alloys. F. W. Gerhard, Wolverhampton, and Jas. Smith, Stoke-upon-Trent. Eng. Pat. 16,651, December 19, 1884.

Ammonia sulphate of magnesia, prepared by crystallising together 228 parts magnesium sulphate and 132 parts ammonium sulphate, and dissolving in 35,000 parts water, is best used at from 150° to 212° F. For white metal, a nickel anode; for magnesium bronze, a copper anode is used; in the latter case the bath consists of magnesium ammonium sulphate 360, potassium cyanide 550, ammonium carbonate 550, water 35,000.
—W. G. M.

Improvements in the Treatment of Sulphide of Antimony to obtain Chlorides, Oxychlorides, and Metallic Antimony. John Hargreaves, Widnes, and Thomas Robinson, Widnes. Eng. Pat. 7206, February 4, 1885.

The bulk of the free acid contained in the solution of chloride of antimony, prepared by dissolving ores containing sulphide of antimony in hot hydrochloric acid, is either removed by evaporation or neutralised with lime or magnesia, and the concentrated solution of chloride of antimony is slowly mixed with water in a wooden or stone vessel provided with stirring apparatus. The precipitated oxychloride of antimony is allowed to settle, the supernatant liquor decanted, and then sufficient milk of lime added to convert the oxychloride into oxide, the mixture meanwhile being kept at about boiling heat. The oxide of antimony is thoroughly washed from calcium chloride, dried, mixed with alkali and free carbon, and reduced to metal in any convenient way.
—A. R. D.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

The Extraction and Treatment of Fats. Dingl. Polyt. J. **253**, 415, 1884.

For the extraction of oil from sesame seeds, maize and the like, Bang and Sanguinetti have recourse to mineral

oil, boiling between 40 and 70°, purified by repeated agitation, first with sulphuric acid of 66° B., then with two or three per cent. of fuming sulphuric acid. The naphtha thus purified leaves no odoriferous matter, either in the oil or in the seeds. The form of apparatus patented (Austro-Hungarian Patent of July 5, 1883) is shown in Fig. 1. The ground seeds are contained in the metal basket *e*, which is inserted in the boiler R, the cover *n*

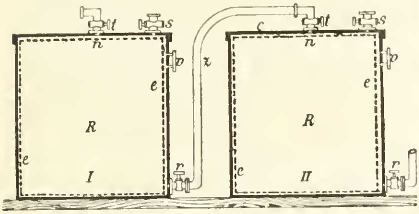


Fig. 1.

being then placed on *e*, and the lid *c* tightly fitted on R. The purified naphtha is run in through *t*, displaced air escaping at *s*. After about fifteen minutes' digestion, the second boiler is connected at *r*, with an exhaust arrangement, and the naphtha from the first boiler drawn over, allowed to remain in contact with the contents of R (II.) for fifteen minutes, drawn over into a third apparatus, and thence so on through several more vessels R, until by the process of repeated diffusion a mixture of oil and naphtha is obtained, containing very little of the latter.

is effected advantageously only between the narrow limits of 310° and 315°, the glycerine being decomposed at higher, and the reaction being incomplete at lower, temperatures. If the fatty matter be finely subdivided, however, the limits of temperature may be somewhat wider. For the purpose of subjecting finely divided fatty matters to the action of superheated steam, and at an efficiently regulated temperature, the apparatus shown in Figs. 2 and 3 has been patented. The fat is heated in A to about 100°, and passes thence into the winding tube *a* lying in the bath B, filled with an alloy of 100 lead with 6 or 4 tin, kept as nearly as possible at its melting point 290°. The oil attains to a temperature of about 300°, this being observed by interposing between B and the tower a vessel *h*, through which the oil flows, fitted with tubes open above, but closed below, containing lead melting at 334°, and the above lead-tin alloy melting at 289°. The pipe *a* enters the tower C near the bottom, and passes up to within a small distance from the top, where it is bent over and fitted with a circular spreader, of diameter slightly less than that of the tower. The oil rises to this height either by reason of the elevated position of A, or by the aid of a force pump interposed between A and B. The tower C is constructed of sheet iron, or of cast-iron plates, surrounded with masonry, and is filled with earthenware balls. Superheated steam is passed in at the bottom by *c*, its temperature being observed by aid of *g*, an arrangement similar to *h*, described above. The products of the decomposition of the glycerides are carried away by the current of steam through *d* at the top of the tower, and are condensed. The temperature within the tower may vary from 250° to 400°; it is not advisable, however, to allow it to sink below 280°. Any undecomposed fat is run off from the bottom of the tower by the pipe *i*.—W. D. B.

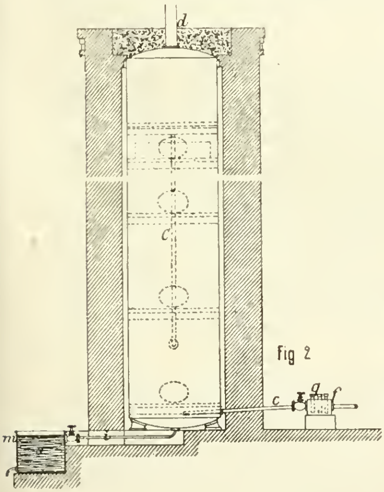


Fig 2

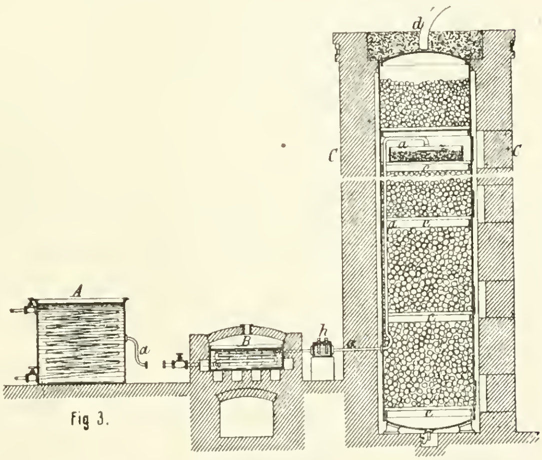


Fig 3.

Successive quantities of fresh naphtha are passed through the apparatus, and when the contents of the first of the series of vessels R are found to be free from fat, connection is made at *r* with a condenser, and superheated naphtha vapour passed in at *s*, until by the temperature of the mass in R, it is evident that all the naphtha retained by the seeds has been vaporised. The stream of superheated vapour is now shut off, and the basket *e* taken from R, the contents being in a completely dry state. If it be desired to remove every trace of naphtha from the seeds, this can be effected by the application of dry steam.

According to O. Korschelt (Ger. Pat. 27,321, September 4, 1883), the saponification of fats by superheated steam

The Production of Grape-stone Oil. J. v. Jobst. Dingl. Polyt. J. **255**, 450.

As a fatty oil is said to be extracted from grape stones in Italy, the author attempted, although unsuccessfully, to express the oil. By extracting with carbon bisulphide or petroleum ether, about 10 per cent. of a thick green oil was obtained, which is nearly decolourised by filtering through charcoal. It possesses an unpleasant smell and taste, and solidifies at 11°. On standing in the air it becomes rancid and thick. These properties exclude its use for culinary purposes, and also as a lubricating oil. It may be employed for lighting; but better for the manufacture of soap. The production of the oil in small

quantities is unprofitable, and is confined to certain districts, where it is chiefly employed for lighting purposes.—J. B. C.

Preparation of Curd Soap. F. Eichbaum. Dingl. Polyt. J. **255**, 539.

A GOOD curd soap with silvery fracture may be prepared by boiling 700kg. tallow, with soda lye of 15°, to a clear jelly, introducing 450kg. of palm-nut, and 100kg. of cocoa-nut oil, with the requisite amount of caustic lye of 25°, and boiling the whole until a clear jelly, free from froth, is obtained. After about two hours any scum upon the surface is removed, and the soap salted out or precipitated respectively with salt solution of 20°, or caustic soda lye of 40°.—W. D. B.

XII.—PAINTS, VARNISHES, AND RESINS.

On the Manufacture of White Lead. Dingl. Polyt. J. **252**, 372.

ACCORDING to an American Patent (292,119, January 15, 1884), M. Roth and G. Sylvester pass an electric current through a solution of sodium acetate, using leaden plates as the poles. Acetate of lead is formed at the positive pole, and caustic soda at the negative pole. By the mutual reaction of these compounds, lead hydrate is produced, which is afterwards converted into white lead by the action of carbonic acid gas. E. V. Gardner (D. R. P., Cl. 22, No. 25,239, August 19, 1882) heats lead with graphite, carbon, platinum, or some other substance electro-negative to lead, in a solution containing 1 part acetate of lead, or 1 part nitric acid, in 40 parts of water, or acetic acid in 24 parts of water. Basic lead salts, or lead oxide, or lead suboxide, will in this way be formed. After one or two hours, the lead is taken out, and the fluid rendered capable of being used again by the addition of acetic or nitric acid. If the operation be performed in chambers, the lead is so placed as to be in contact with the carbon or platinum. Ozonised air should be conducted into the chamber, or generated therein by electric discharges. The apparatus employed is shown in the figure.—E. G. C.

Analysis of Vulcanised Caoutchouc, including the estimation of the Sulphur. B. Unger. Zeits. Anal. Chem. **24**, 167-174.

THE method adopted for estimating the sulphur in caoutchouc by heating the sample with copper oxide and sodium carbonate, and then, after dissolving in aqua regia, precipitating the sulphate formed with barium chloride, is untrustworthy. Antimony sulphide and sulphur only give a sulphate, when soda is present as well. The presence of alkalies does not retard the reaction, but prevents the dissociation of the sulphuric acid at the high temperature necessary for the complete combustion. The antimony sulphide used in the English manufacture contains free sulphur (6·30 per cent.) and gypsum (9·62 per cent.). The sulphur of the gypsum present is not available for vulcanisation, so that the determination of the amount of sulphur in the caoutchouc should be accompanied with the percentage of calcium as well as that of the antimony present. The author recommends the following processes:—

1. *Sulphur.*—About ·5grm. of the sample is cut into fragments and heated with 12grm. copper oxide and 2grm. soda, in which the amount of sulphate present has been previously determined. The copper oxide is prepared by heating well-washed copper carbonate. The caoutchouc is added to the crucible in small quantities at a time—the progress of the reaction and the amount of heat can be regulated by observing the smell emitted which should be pleasant and aromatic (not unlike kümmel). The product is dissolved in aqua regia and evaporated over a water bath to dryness to render the antimonic acid insoluble, and to obtain a solution which can be easily filtered. After treating with water, filtering and washing, the filtrate is diluted to 600cc. The sulphate is then precipitated with barium chloride in the usual way.

2. *Antimony.*—About 1·5grm. of the substance is cut up into fragments and heated with 10grm. of crystallised sodium sulphide. The product is triturated with water and filtered, and then the filtrate is heated with hydrochloric acid. The mixture of antimonious sulphide and sulphur is weighed on a tared filter paper, and the result checked by heating a known portion with excess of sulphur and reweighing.

3. *Calcium.*—About 2·5grm. are incinerated in a porcelain dish, and the temperature gradually raised to redness. The ash is heated with strong hydrochloric acid and allowed to stand for 24 hours. The solution is diluted with water to precipitate the antimony as oxide, and ammonia is added in excess to complete the precipitation. To the filtrate ammonium oxalate is added, and the calcium is then weighed as carbonate in the ordinary manner. The results are calculated out to give the percentage of—Sb_2S_5, $CaSO_4.2H_2O$, and free S in the caoutchouc. The amount of rubber present is given by difference.

Another mixture used in England to give a black vulcanised indiarubber contains—

66·55	Talc (with FeO; Al_2O_3; H_2O).
21·10	Litharge.
4·30	Zinc Oxide.
8·05	Sulphur.
100·00	

With lead present as in this last case, when the sample is heated with copper oxide and soda, the sulphate formed is chiefly lead sulphate, which can be dissolved out from the residue with ammonium acetate. Part of the lead sulphate and the zinc are estimated in the copper solution, and a second sample is heated first in the air and then with soda to find the percentage of talc present.—S. R.

Improvements in, and in Apparatus for, the Manufacture of Lead Salts for making White Lead. W. V. Wilson, Middlesex. Eng. Pat. 6464, April 17, 1884.

THE apparatus described has for its object the formation of solutions of basic lead salts by causing finely divided metallic lead to be exposed alternately to the action of air and steam, and then of a solution of neutral acetate or nitrate of lead. It consists of a revolving drum provided internally with shelves, on which the lead is raised and allowed to fall on a perforated cylinder also provided with shelves, and revolving in the centre of the drum. Air and steam or hot air is sent through the drum at the central bearings, which are made hollow, and the drum is kept half-full of solution of acetate or nitrate of lead. The treatment of the basic lead solution takes place in another vessel.—G. H. B.

Improved Means and Apparatus for Facilitating the Dissolution of Metallic Lead, or of Oxide of Lead in the Manufacture of White Lead. A. W. Anderson, London. Eng. Pat. 5166, December 18, 1884.

A HOLLOW wooden drum rotating slowly on a hollow axis has a number of radial shelves projecting more or less towards the centre, and on the axis of the said drum are secured other radial shelves projecting towards the circumference. The hollow axis is perforated and provided with a partition so that a hot blast of air may be admitted to the drum on the one side of this partition, and escape through the perforations on the other side. Finely-divided lead is placed in the drum, which is then partially filled with suitable solvent liquid, and caused to rotate. By this means the lead, being alternately exposed to the action of the solvent liquid and the blast of hot air, is rapidly dissolved. When the liquor is sufficiently concentrated it may be drawn off for the precipitation of the lead with carbonic acid gas, or this precipitation may be effected in the drum itself.—A. R. D.

XIV.—AGRICULTURE, MANURES, Etc.

Improved Process and Apparatus for the Utilisation of Human Excreta, Drainage from Stables, and the like. W. P. Thompson. From J. R. Bryden, Georgetown, British Guiana. Eng. Pat. 6441, April 17, 1884.

This invention is based on the fact that if sewage matter be received in reservoirs, in which it can be kept out of contact with outside air and in contact with soil, a natural chemical process ensues resulting in the transformation of the excrements into a liquid manure containing nearly all the valuable nitrogenous matter of the sewage. By natural filtration through the soil, animal and vegetable remains become disintegrated, the decomposing matter being finally converted into nitrates. A series of underground closed reservoirs with earth bottoms receive the sewage which is afterwards utilised for manurial purposes.—E. G. C.

Improvements in the Manufacture of Phosphates. F. W. Harbord, Wolverhampton. Eng. Pat. 7562, May 10, 1884.

The object of this invention is to obtain phosphates practically free from iron from the slags resulting from the Thomas-Gilchrist process, or from other phosphatic materials containing iron. The phosphate is finely ground and freed as far as possible from metallic iron. It is then treated with very dilute acid, care being taken to dissolve as much phosphoric acid as possible. The solution is separated from the residue and steam, and air blown through it, in order to peroxidise the iron. A solution of a ferrocyanide is then added in just sufficient quantity to precipitate all iron in form of Prussian blue, which is separated and treated to recover the ferrocyanide. The phosphatic solution may be worked up for free phosphoric acid or precipitated with chalk or lime, if precipitated phosphate be required.—S. H.

Improvements in Treating Phosphates of Calcium or Lime. P. M. Justice. Eng. Pat. 7963, May 20, 1884.

This invention relates to the treatment of phosphates of lime which may be in a dry or humid state, and consists in first calcining and decarbonating them, and subsequently subjecting them to the action of cold or hot water or steam, and as soon as they are cold subjecting them to a high temperature. By this means the material is more thoroughly decarbonated, and a more perfect division or disintegration obtained, the material being left in a condition to permit of the easy elimination of the lime by any of the ordinary means.—S. H.

XV.—SUGAR, GUMS, STARCHES, Etc.

Extraction of Sugar from Molasses. Dingl. Polyt. J. **253**, 421.

In the extraction of sugar from molasses by his strontia process, Scheibler now avoids the formation of bistrontium saccharate by adding to the mother liquors and washings separated by filtration from the monostrontium saccharate prepared as originally described, further amounts of molasses and strontium hydrate in the proportion requisite for the production of monostrontium saccharate. The mother and wash liquors are thus worked up repeatedly until they contain so much non-saccharine matter as to prevent further advantageous treatment. After 6 or 8 successive operations, the sugar remaining in the liquors need not amount to more than 4 or 3 per cent. of that originally present in the molasses treated. The ammonium chloride osmose process as carried on at the sugar refinery at Haussy is described by Dureaus in *Journ. des Fab. de Sucre*, 1883, No. 46. The syrup separated from product I is mixed with 1 per cent. of ammonium chloride, heated to 100° and subjected to osmose with 10-12 parts of water at 75°. After this treatment the syrup has a density of 11° B. (hot), the proportion of sugar to mineral matter being 12 or 14 to 1, whilst the original proportion was 5 or 6 to 1. The osmosed syrup is added to fresh juice. In the *Zeit. deut. Ver. Rubenzucker-Ind.* 1884, p. 85, details are given of the working of Stutzer's precipitation process, depending upon the precipitation of calcium saccharate from an alcoholic solution of the molasses. It has been shown by experiment, that the precipitation of the calcium saccharate takes place most readily if the lime has previously been slaked in spirit, whilst the precipitation is effected both slowly and incompletely if the lime be introduced as powder. From this it appears that the lime when hydrated combines more readily with sugar than when in the form of oxide, especially in a saccharine solution containing alkali. The hydroxides of barium and strontium behave similarly.—W. D. B.

Sugar-Beet Culture. Dingl. Polyt. J. **255**, 354.

For the valuation of sugar-beet seed, Sempotowski (*Deutsche Zucker-Industrie*, 1884, pp. 272 and 1280) allows 5 grammes to germinate at 20° in a wooden box filled with sifted garden soil. From 1 gramme of very good seed 81 to 112 sprouts may be expected, of good from 55 to 80 sprouts; a sample of seed giving less than 40 sprouts per gramme is to be regarded as bad. The best results in cultivation trials, made in Saxony in the year 1883 by Maercker (*Neue Zeit. fur Rubenzucker*, 1884, 12, pp. 142 and 257), were obtained with Dippe's improved "Little Wanzlebener Beet." The best nitrogenous manure for the potato and sugar-beet is, according to Wagner, not ammonium sulphate but Chili saltpetre. That the former has under certain conditions—such as moist, warm weather, or on soils rich in lime and humus and especially rapid nitrification—given as good results as the latter is not denied. On the other hand there is no undoubted case on record where manuring with Chili saltpetre was followed by a worse crop than that with ammonium sulphate. P. Dehérain (*Compt. Rend.* 1884, 99, p. 920) found that the "Vilmorin" variety, unmanured, yielded a juice of which 100 parts contained 19 parts of sugar, and that, with favourable weather, a plot manured yielded beets equally rich in sugar. The advantage gained by the application of manure was the increase in total crop: 1 hectare, unmanured, gave 29,700kilos.; manured with stable dung, 35,000kilos.; with stable dung and Chili saltpetre, 43,000kilos. of beet. From experiments conducted at the experimental station at Gembloux as to the best method of applying artificial manures, it appears that upon sandy-clay soils a surface dressing after harrowing is not sufficient, since the absorptive powers of such soils are so great as to prevent, even in wet years, the plant food from finding its way to the tap-root. The manures are most advantageously dug in for some depth in the spring-time. The results of Corenwinder's experiments as to whether the sugar beet derives the carbon of its sugar contents mainly from the atmosphere, are instructive. The plants were cultivated partly in pure sand containing the necessary salts, partly in a manured soil, partly in the open. The following results were obtained:

	Total Weight of		Composition of Root.		
	Leaves.	Root.	Water.	Sugar.	Ash.
Sand	270g.	490g.	80·8	12·26	0·98
Manured Soil	2560g.	1145g.	83·8	10·60	1·16
Open Field ...	......	......	83.2	9·00	0·91

The beet grown in pure sand thus produced 61 grammes of sugar, for the formation of which 31cc. of carbonic acid must have been assimilated on an average per diem.
—W. D. B.

Analysis of Honey. E. Sieben. Dingl. Polyt. J. **255**, 441.

The amount of cane-sugar in the samples was determined by Meissl's method by difference before and after inverting with dilute hydrochloric acid. The method of Sachsse for estimating dextrin compounds present by boiling with hydrochloric acid, and thus converting them into grape-sugar is unreliable. A method for estimating the grape-sugar in honey is to boil with an excess of sixfold normal hydrochloric acid, which destroys the

levulose. After neutralising with caustic soda the grape-sugar is determined according to Allihn. The difference in the amount of grape-sugar given by this method and that of Sachsse-Fehling varied between $-2\cdot44$ and $+2\cdot29$. The analyses show that in the majority of cases grape-sugar and levulose are present in nearly equal quantities. In most samples cane sugar is absent, the highest percentage found being about eight. The amount of water varied between 16 and 25 per cent., and the amount of non-sugars, including wax, between 1 and 9 per cent. The author gives a useful review of the methods for detecting starch-sugar syrup used in the adulteration of honey. The sulphuric acid reaction is condemned, as pure honey also contains larger or smaller quantities of this acid. Precipitation with alcohol cannot be employed as not only is the dextrin of the starch-sugar thrown down, but also albumen and other substances present in the unadulterated article. The method proposed, which will detect the smallest trace of this adulteration, is based upon the following facts. Solutions of honey, in which the cane-sugar present has been inverted, when heated with a slight excess of Fehling's solution contains no longer any substance which on further heating with hydrochloric acid forms sugar. Starch-sugar syrup, on the other hand, by a similar treatment yields for every 100grm. syrup nearly 40grm. grape-sugar. 14grm. honey are dissolved in 450cc. water and heated with 20cc. of half normal hydrochloric acid for half an hour on the water bath, by which the cane sugar is inverted. It is neutralised, made up to 500cc. so that a 2 per cent. invert sugar solution is obtained. 100cc. Fehling's solution is titrated with this solution. It is filtered through asbestos, washed with hot water, neutralised with concentrated HCl, and ·1 volume of concentrated HCl added, and then heated for one hour on the water bath. The solution is nearly neutralised with concentrated NaOH solution and made up to 200cc., 150cc. of the filtered solution is heated with 120cc. Fehling's solution and 20cc. water, and the grape-sugar estimated according to Allihn from the weighed copper.
—J. B. C.

Apparatus for the Manufacture of Starch. Dingl. Polyt. J. 256, 35.

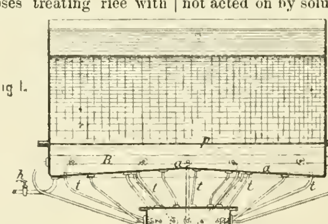
FOR the manufacture of rice-starch H. Mack, Ulm (Ger. Pat. 30,256, 1884), proposes treating rice with caustic soda, and blowing air under pressure at the same time through the liquid in such quantities that the latter assumes the appearance of a boiling liquid. For this purpose air enters through many small tubes *t* (Fig. 1) into a tank B provided with a false bottom *p*, on which finely ground rice is spread, whereas the tank is filled with a very dilute solution of caustic soda. After finishing the operation the caustic liquid is run off at *h*, and the rice-starch formed allowed to drain on the perforated bottom. The inventor states that by the aid of large volumes of air the rice softens quicker, and yields from 6 to 8 per cent. more of the finished product, thus saving time, plant, and chemicals.

L. Fehrmann, Parchim (Ger. Pat. 29,600, 1884), uses for drying starch a drum revolving round a shaft *a* (Figs. 2 and 3). Discs *d* are screwed to the journals *c*, and serve as a support for the ends of a great number of iron rods. From the centre of each disc also issue the distributing rods *b*, which meet in the middle, where they are fastened to a wheel *c*. Starch enters the apparatus at *g*, and being seized by the outside row of rods it is carried to the highest point of the drum, falls to the next series of rods and so forth, until it arrives at the bottom only to make the same way over again. The drum inclines towards the outlet, and the revolution thus causes the mass to proceed gradually to the outlet *z*. When it arrives here it is dry, and in a finely divided state. The warm air necessary for drying travels in a channel along the whole length of the drum, and escapes at the top, deprived of its heat, into an air-filter, which retains the powder mechanically carried away.—S. H.

The So-called Plus-Sugar. E. von Lippmann. Zeits. deut. Zucker Ind. 1885.

THE author has found needle-shaped crystals of a sugar, so-called plus-sugar, in molasses, which appear to be identical with the substance examined by Tollens (Ber. 18 [1], 26). Being readily soluble in dilute alcohol and water the crystals were separated from the molasses by means of absolute alcohol. Analysis gave numbers corresponding to the formula $C_{12}H_{22}O_{11}+3H_2O$, which agrees with Tollen's formula. A 10 per cent. solution shows a specific rotation $[\alpha]_D=105$ at 19°. The sugar is insoluble in absolute alcohol and ether, is not precipitated by lead acetate except in an ammoniacal solution, and is not acted on by solutions of alkalies or alkaline earths. It does not reduce Fehling's solution, but after treatment with acid becomes strongly reducing. The presence

Fig 1.



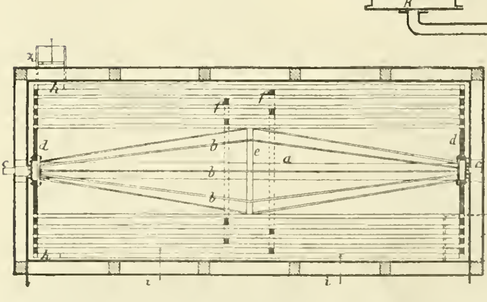


Fig 2.

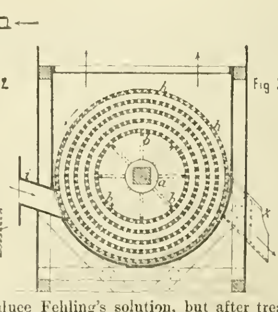


Fig 3.

of this sugar is the cause of the occurrence of needle-shaped crystals in raw sugar extracted from molasses, and of the high rotation of such sugars.—D. B.

Improvements in the Extraction of Sugar from Molasses and other Saccharine Products, and in the Quality of Alkaline Salts resulting therefrom. Victor Daix and Antoine Louis Possoz, Paris. Eng. Pat. 7235, May 5, 1884.

THIS process consists in osmosing molasses or other saccharine products, and then precipitating the sugar from the exosmose waters, molasses, and other residues, as sucrates of lime, strontia, or baryta. The mother waters which have been exhausted of sugar are concentrated, and nitrate of soda is then added in sufficient proportion to transform the chlorides and other potassic salts into nitrate of potash, which can be more easily obtained from the liquors than the original potash salts. —A. W.

A New or Improved Process for obtaining Sugar from Saccharine Substances. C. D. Abel. From Dr. Ludwig Harperath, Cologne. Eng. Pat. 7982, May 20, 1884.

THIS process consists in treating molasses, diffusion juices, or other saccharine solutions with burnt natural dolomite or a calcined mixture of magnesia and lime, so as to produce a magnesian lime saccharate, which is more permanent than the lime saccharate, and is not so subject to retrogressive action. As little or no development of heat takes place on the admixture of the dolomite with the saccharine solution, no special cooling appliances are required. The magnesian lime saccharate, in contradistinction to the poly-basic lime saccharates, always forms without cooling, and even at temperatures above 50° C., but not between 30° and 50° C. Cooling is only required when the atmospheric temperature reaches or exceeds 30° C., as the reaction will not commence above that temperature. The purification and decomposition of the saccharate is effected by known methods. —A. W.

Improved Apparatus for Osmose Treatment of Saccharine Liquors. J. Imray, London. From H. Leplay, Paris. Eng. Pat. 8502, May 31, 1884.

THIS apparatus is a modification of the well-known "osmogene" of Dubrunfaut. In conducting the process of osmosis in Dubrunfaut's apparatus, the molasses or other liquor under treatment becomes gradually more dilute as the process goes on, and this increased dilution is accompanied by a corresponding decrease in useful effect—in other words, as the liquor becomes more dilute, the proportion of salts eliminated from the molasses becomes smaller, and the loss of sugar into the osmose water greater. In order to avoid this difficulty the author adopts a novel arrangement which he designates "evaporative osmogene with strong osmose." The upper parts of each of the 100 constituent frames of the osmogene are so arranged as to form a reservoir of liquid above all the frames, and this reservoir communicates directly with the molasses cells of the osmogene, and is supplied with a coil of closed steam pipes. By this means evaporation is maintained in the liquor undergoing osmosis, and the dilution which would otherwise ensue is counterbalanced. Full description with diagrams is given.—A. J. K.

Improvements in Osmose Apparatus. C. D. Abel, London. From H. Leplay, Paris. Eng. Pat. 9243, June 20, 1884.

THIS invention relates to an improved construction of apparatus for the osmose treatment of saccharine and other liquors, which is termed "steam osmogene with triple action," and which produces simultaneously the three following results: (1.) The separation of the salts contained in the liquors treated. (2.) The evaporation of the liquids of exosmose. (3.) The evaporation of the osmose liquids. The simplest form of this apparatus is as follows:—A metal tank is divided by a horizontal perforated metal partition, on which is placed the parchment paper, into an upper and lower compartment; the latter serves to evaporate the liquid of exosmose, and to furnish the steam required for the osmose action. The upper compartment receives the liquid to be subjected to the osmose treatment. The lower compartment is supplied with a steam coil, supply and discharge pipes, cocks, etc. The action of the apparatus is as follows:—The lower compartment is in the first instance charged with water to sufficient depth to cover the steam coil, whilst into the upper compartment is introduced a layer of molasses or other liquor to be osmosed. The apparatus can be worked either continuously or intermittently; in the latter case the water in the lower compartment is heated to boiling point by the steam coil; the steam produced is condensed against the underside of the parchment paper diaphragm, and is partly absorbed by the current of endosmose passing to the molasses through the diaphragm, while the other portion mixes with the salts of the exosmose current, and falls back into the lower compartment. The molasses become heated, and increase in volume and decrease in density in consequence of the absorption of the water by the current, and rapidly reach 30° B. Arrived at this point, a kind of equilibrium ensues. About the same quantity of water which the molasses receive is separated by evaporation from the surface. As the operation proceeds, a large quantity of the salts passes from the molasses into the exosmose water in the lower chamber; when the required purity is obtained, the osmosed molasses is run off, and a fresh charge put in, whilst the same water in the lower compartment can be used over again until it is thoroughly charged with salts. When operating continuously, a small continuous stream of molasses is admitted into one end of the upper compartment, and escapes at the other end. As the condensation of the steam in the lower compartment will not be effected if the temperature of the osmosed molasses rises too high, such temperature may be reduced by means of air currents on the surface, or by a zigzag coil of cold water-pipes through the molasses. The osmose apparatus above-described requires to be placed horizontally, necessitating a large amount of surface in the factories, which is often inconvenient. In addition to this, there is often considerable loss of heat, and waste of fuel by the evaporation taking place from the surface of the molasses. To obviate these disadvantages, a second osmose compartment may be placed above the first, and a third again above that, so that the liquor in each cell acts as exosmose to the one above it, and the steam from the lower is in each case condensed on the surface of the diaphragm above it. Another arrangement for still further economising space is as follows:—The exosmose compartment at the bottom is formed, as before, of a horizontal tank heated by steam coil or otherwise. Above this, however, instead of the horizontal perforated plate and diaphragm, there is arranged a series of vertical wedge-shaped pockets (apex down), whose sides are made of wire gauze, lined with parchment paper. At the top, these pockets unite to form one large shallow vessel, which, as before, contains the molasses or other liquor to be osmosed. By this means much larger surface is obtained, but otherwise the process is conducted as described in connection with the more simply-constructed apparatus.—A. J. K.

Improvements in Means and Apparatus for Bleaching Sugar. C. H. Day, High Holborn. From C. O. Foster, Brookline, U.S.A. Eng. Pat. 1972, February 12, 1885.

THE invention consists of a special apparatus for the treatment of crystalline or granular sugar by sulphurous acid gas. The sugar is made to pass slowly through a rotating drum, provided with shelves inside for regulating the motion of the sugar. The sulphurous acid gas is generated by burning sulphur in a small furnace, and after being cooled by suitable means, is forced into the cylinder with the sugar by means of a jet of dry steam or of air. At the other end of the cylinder the sugar is delivered into a hopper, and the gas escapes up a flue. —A. J. K.

Improvements relating to the Preparation of Food for Animals from the Refuse of Breweries, or of Starch and Glucose Factories, and Apparatus therefor. W. R. Lake, London. From F. W. Weisebrock, New York, U.S.A. Eng. Pat. 2208, February 17, 1885.

Brewers' grain, as well as the refuse from starch and glucose factories, are well known to be wholesome food for cattle, provided they can be used in a fresh state. These bodies contain carbohydrates and albuminates, and on keeping for any length of time, are liable to undergo fermentation, with formation of lactic and other acids. The author states that the various processes which have been devised for drying brewers' grain and similar materials have failed to produce a sweet and wholesome food, owing to the fact that the air used for drying has not been freed from active fermentation germs. As a result the article contains a large proportion of dry lactic acid, which is no more desirable than the same material in the moist state. It is claimed that by the invention herein described this objection is overcome. The brewers' grain or refuse is first mixed with salt or salt water in proportion of 5lb. salt to 1 ton of the grains, with the object of keeping the latter sweet during transit from the place of its production to the drying apparatus. The wet grains thus salted are next subjected to the action of dry air, from which all active germs have been previously removed by exposure to a temperature of over 400° F. By this means, when thoroughly dried, a sweet and wholesome food is obtained. Special apparatus, suitable for carrying on the necessary operations, is fully described.—A. J. K.

Improvements in Apparatus or Devices for the Treatment of Sugar Cane. H. J. Chapin, New York, U.S.A. Eng. Pat. 2553, February 25, 1885.

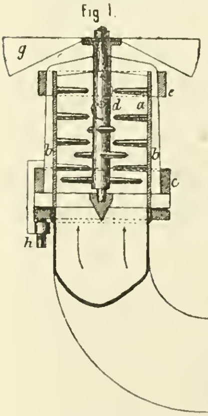
The inventions described under this specification "consist of a cane shredder of improved construction and mode of arrangement, of improved devices for conveying the shredded cane and juice from the shredder to the juice extractor, and of the more convenient arrangement—relatively to each other—of the mechanical elements or members of the combination therein described." Full description, with copious reference to diagrams, is given of the construction and arrangement of machinery above mentioned.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

Apparatus for Spirit Distilleries. Dingl. Polyt. J. **255**, 345.

A Disintegrator, patented by Gaul and Hofmann (Ger. Pat. 27,351, September 19, 1883), to be connected

Fig 1.



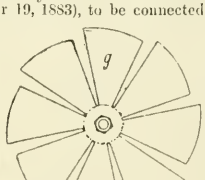


Fig 2.

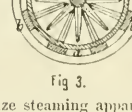


Fig 3.

with the delivery pipe of a Henze steaming apparatus, is shown in Figs. 1, 2, 3. The disintegrator is clamped by h to the delivery pipe. The steamed grain as it leaves the disintegrator falls upon the wheel g, which gives a rotary motion to the graters fixed upon the spindle d.

The disintegrator patented by Hall (Ger. Pat. 27,807, November 22, 1883), illustrated by Figs. 4 and 5, is intended to be attached at A to the delivery pipe of the

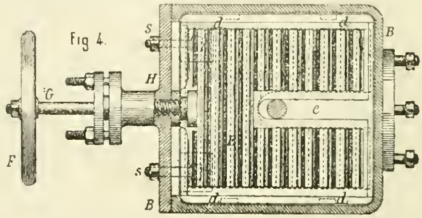


Fig 4.

steaming apparatus. Supported by d, there is a double grating, of which the under half D is stationary, but the upper half E movable in a direction at right angles to the bars by the screw at the end of FG. The slits of the grating can thus be closed entirely, or their width adjusted at will. The side H can be easily removed for

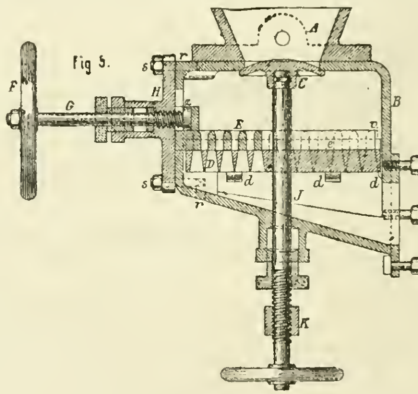


Fig 5.

the purpose of cleaning the gratings. Upon opening the valve C, the contents of the steamer enter B, and by the steam pressure are forced through the slits of the gratings in a very finely divided condition, stones and large or hard particles being caught by E.

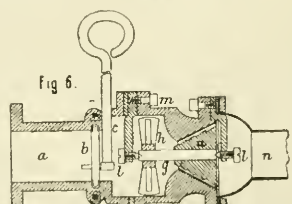


Fig 6.

Wösler's disintegrator (Ger. Pat. 28,278, December 21, 1883) is shown in Figs. 6 and 7. It is attached at a to the delivery tube of Henze's steamer. Stones and similar substances are caught by the movable grating b, which is kept clean by the rake c. Accumulated stones are removed at the manhole e. The ribbed cone

u, forming the grinding apparatus, is rotated by the wheel *h*, which the rapid flow of material from the steamer sets in revolution. The tap *o* serves for the introduction of water

The washing and cooling apparatus patented by Hampel (Ger. Pat. Addition 28,891, February 5, 1882)

Fig 7.

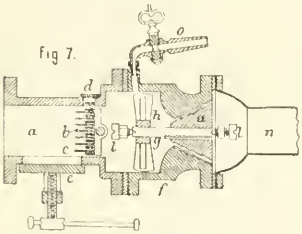
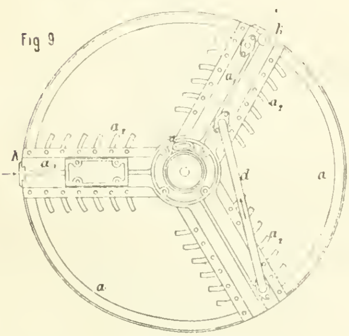


Fig 9



is shown in Figs. 8, 9, 10. The cooling water enters at K, and takes the course indicated by the arrows. The steamed grain or other material is forced by steam pressure through the tube *u* into the vessel *a*.

—W. D. B.

Liquorice Root in Beer Brewing. R. Kayser. Dingl. Polyt. J. **255**, 538.

It has been found by experiment that 1 part of liquorice root imparts to water the same degree of sweetness as 8·5 parts of sugar-candy. Thus in sweetening efficiency one part of glycyrrhizin is approximately equal to 140 parts of sugar-candy. Since glycyrrhizin is not affected by fermentation like sugar, the addition of 1 kilo. of liquorice root to 500 litres of wort will give a sweeter beer than if 8·5kilos. of sugar had been used.

—W. D. B.

Analysis of Pure Wine. W. Klinkenberg. Zeits. Anal. Chem. **23**, 514.

Samples of wine from Saar were analysed by the following method :—100cc. were distilled with milk of lime to fix any CO_2 present, and the alcohol estimated from the specific gravity of the distillate. The amount of extract was estimated by evaporating 50cc. to a syrup on the water bath, and drying in a steam oven. The acid present, after freeing from CO_2 by boiling, was determined by titration with baryta solution. For the mineral constituents 100cc. were taken in each case. CaO and MgO were determined directly in the wine, the sulphuric acid after decomposing organic matter with $KClO_3$ and HCl, chlorine, phosphoric acid, and the alkalis in the ash. Wild's instrument was employed for polarisation.—J. B. C.

Estimation of Wine Extract. C. Weigelt Rufach. Zeits. Anal. Chem. **24**, 26-30.

Wine extract is defined as the sum of the non-volatile substances. The author discusses the relation existing between the sp. gr. of the solution and the weight of the extract, and a tabular statement is appended showing

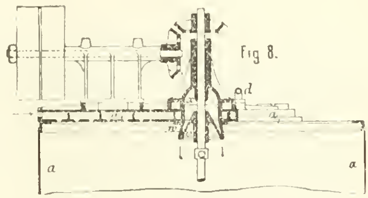
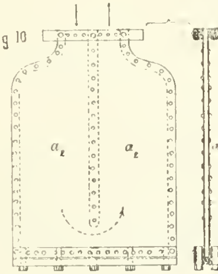


Fig 8.

Fig 10



that the indirect method for estimating the amount of extract is comparable with the direct method in wines of very various qualities and specific gravities. The percentage of extract can also be calculated by finding the sp. gr. from Balling's saccharimetric tables, and the numbers so obtained agree satisfactorily with those obtained by the other two methods.—S. R.

New Apparatus for the Treatment of Hops. Dingl. Polyt. J. **255**, 165.

A boiler, devised by A. Steinecker, is shown in Figs. 1 and 2. It is furnished with a double bottom ; while the bottom, sides and lid of the hop-basket are made of perforated tin or wire-netting, as in the boilers A and B, or it is, instead, only an enclosed sieve, as in the boiler C. In the centre of the boiler is a tube *l*, provided with a head-piece, which scatters the boiling water around, and by means of which the hops are kept continually soaked during the boiling. The vessel being filled with fresh hops, the cock *c* is opened to admit steam from the pipe D, while the cock *f* is also open to allow of the exit of the steam and volatile oil of hop, which pass by the pipe *g* beneath the surface of the wort. After the steaming, hot water is injected through the cock *o* and the rose *n*. This water, together with dissolved volatile oil and condensation water from the steam, passes into the wort by the cock *e* and tube *g*, the cocks *c* and *a* now being shut. If the steam and scalded hops are to be heated in the next boil, the steam-cock *a* is opened, water having been already admitted the day before and left to stand. This water is soon raised to the boiling point. While the lid *m* is still closed, the cock *f* remains open, so that the steam produced can reach the wort through the tube *g*. The steam-cock *a* is closed

after each boil, *f* remains open, *e* is opened and the aqueous extract is drained off into the wort-pan. The boiling with water having been repeated from two to four times, the lid is removed, and the hops are transferred to the wort. According to A. Kempe, of Moscow, 55kilos. of hops are sufficient for one boil, in place of the 70kilos. generally used by brewers. At the beginning of a boil, 33kilos. of hops are thrown into the wort; this is boiled for three to three and a half hours, and then transferred to the cooler in the usual manner. Twenty-two kilos. of hops are placed in the inner iron or tinned copper boiler A (Fig. 3), provided with a stirrer D, and either wort or water is now added through the pipe F, the fluid penetrating also into the spaces B and C, through the sieves JJ. When all the valves are closed, steam is allowed to enter by the cock K in the casing A_1. The hops and fluid in A are hereby brought to the boiling temperature, or even higher, the amount of pressure being indicated by the manometer M. In order to quicken the exhaustion of the hops, the valve *o* is opened, so that the fluid passes through the depositing vessel V and the tube *v* into a cooler placed above the boiler, flows through the spirals present therein, then through the gauge-glass S, and the valve O, into the chamber B, and finally, through the sieve J, back into the chamber A. Should sufficient

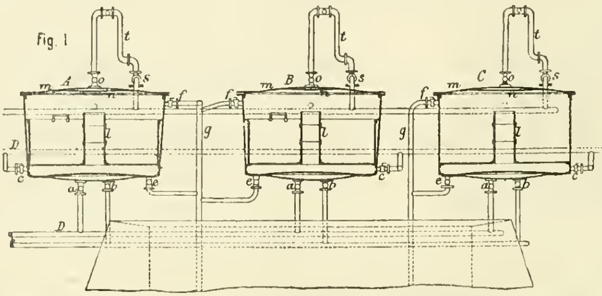


Fig. 1

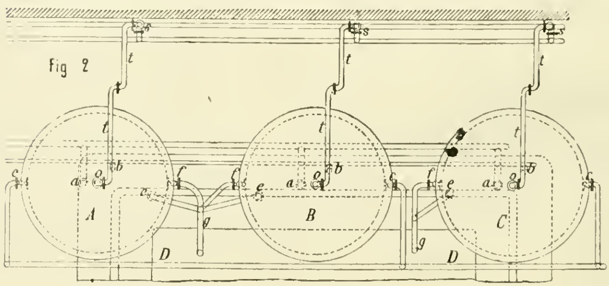


Fig 2

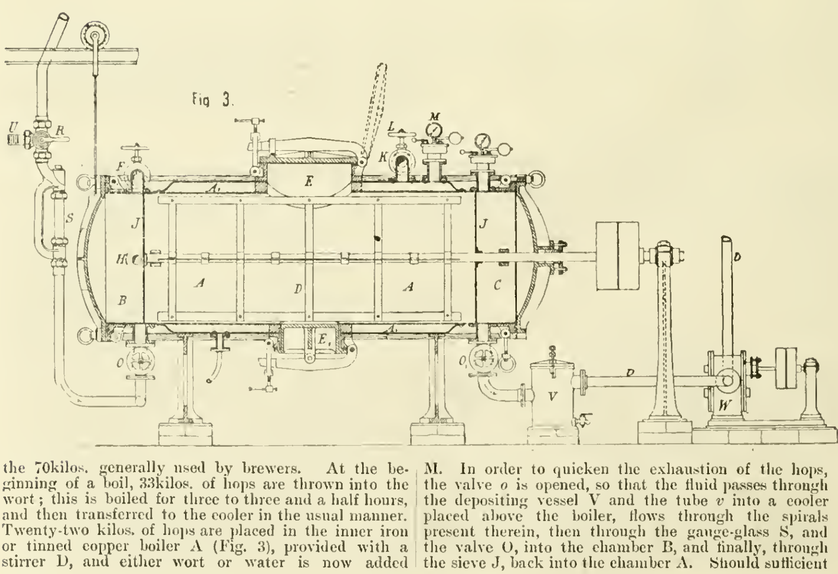
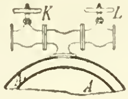


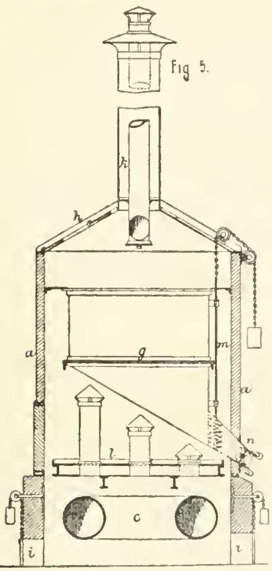
Fig 3.

cold water for the cooling not be at hand, so that this circulation cannot be effected, the pump W is employed. Hünerkopf & Son and F. Rutschmann, of Nüremberg, do not at once add the entire hops to the hot wort, but

Fig 4



dry them at a temperature of not more than 38° in the drying apparatus shown in Fig. 5, until they become greatly disintegrated and fall asunder into powder under the action of a rake. The drying chamber is con-



structed so that the temperature can be regulated with the greatest nicety. In order to effect the removal of moisture from the hops as quickly as possible, passages

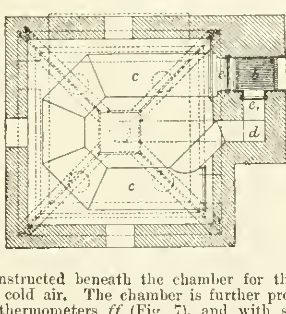
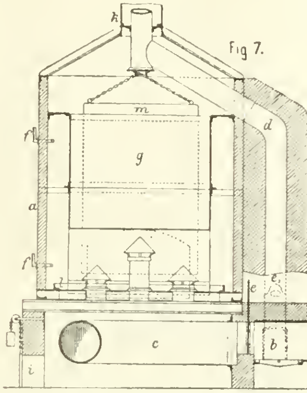


Fig. 6.

(*ii*) are constructed beneath the chamber for the admission of cold air. The chamber is further provided with two thermometers *ff* (Fig. 7), and with sliding doors *e* and e_1, which latter serve to screen off the fire *b* when necessary. The box *g* is made of fine perforated tin, and is filled with hops from the trap-door *h*. When the drying is completed, the slide *m* is pulled up and the hops are allowed to fall from *g* on to the cylindrical



rake *n*, and to pass from thence, in a finely divided condition, into sacks ready to receive them.—E. G. C.

Contributions to our Knowledge of Caramel. C. Amthor. Zeits. Anal. Chem. **24**, 30-33.

Paraldehyde destroys the colour of an alcoholic solution of caramel, and forms at the same time a brown precipitate. This reaction is made use of by the author for determining the amount of caramel added to wines and spirits. A standard solution of caramel is prepared by caramelising 10grm. of pure cane sugar and dissolving the product in water. Any undecomposed sugar is then destroyed by fermentation, and the solution is diluted to 100cc. A solution of paraldehyde in absolute alcohol completely destroyed the colour of this solution after twenty-four hours. With pure white wine, natural wine, and extract of raisins, paraldehyde gives a white precipitate; the caramel precipitate can be further identified by its reaction with phenyl-hydrazine. A solution containing two parts of phenyl-hydrazine hydrochlorate with three of sodium acetate dissolved in twenty of water, gives with solutions of caramel a brown precipitate soluble in warm ammonia, or weak caustic soda to a red liquid, and is reprecipitated from this alkaline solution by the addition of hydrochloric acid. The precipitate is soluble in concentrated hydrochloric acid or nitric acid, but is reprecipitated on diluting with water. Alcohol similarly dissolves it, and water reprecipitates it after some time. The method adopted in testing for caramel in white wines or spirits is as follows:—10cc. of the liquid (if a wine 10-15cc. of alcohol are first added) are placed in a tall glass cylinder, and 30-50cc. of paraldehyde solution added, together with sufficient absolute alcohol to make the two liquids mix. After twenty-four hours the precipitate is collected, washed with alcohol, and dissolved in warm water. The clear filtered solution is then evaporated to 1cc.—the intensity of the colour is a measure of the amount of added caramel. With very small quantities it is best to evaporate the solution over sulphuric acid in the receiver of an air-pump. The solution must not be warmed, or a caramel-like precipitate is obtained even with the purest wines. The concentrated solution of the paraldehyde precipitate can then be treated with phenyl-hydrazine solution, when the caramel phenyl-hydrazine precipitate is thrown down. If the solution is weak it first only becomes cloudy, but the precipitation is complete after standing for a day. Any resinous bodies present can be dissolved out by ether, which has no action on the precipitate. Phenyl-hydrazine, unlike

paraldehyde, gives no precipitate with natural wines. Wines containing a large percentage of sugar should be diluted before trying the above reactions.—S. R.

The Sugar and Acids in Must. E. Schmidt. Zeits. Anal. Chem. **24**, 33.

The following table shows the percentage of sugar and acid in the must from Montreux and Villeneuve during the last five years :—

Montreux.	Sugar %	Acid %	Villeneuve.	Sugar %	Acid %
1880	15·2	0·9	......	......	......
1881	17·8	1·1025	......	......	......
,,	17·5	1·0867	1881	18·525	1·1025
1882	16·6	1·085	1882	16·726	0·9075
1883	16·9	1·085	1883	17·64	1·1025
1884	15·7	0·915	1884	15·23	1·005
,,	16·8	0·924	,,	15·	1·0935

Last year's must from Villeneuve is exceptionally low in sugar, since owing to a hailstorm a great part of the grapes had to be plucked before they were quite ripe. —S. R.

Improvements connected with Preserving, Storing, and Aerating Lager and other like Beers. W. Aubert, jun., Balham. Eng. Pat. 5747, March 31, 1884.

The beer is stored in iron drums having a pipe reaching to the bottom, through which carbonic acid under pressure is forced in, so as to charge the contents. The pipe also serves as an outlet when the contents of the drums are discharged. A modification of the apparatus is also described and shown, in which a spherical vessel is placed in the interior of the drum, charged with carbonic acid gas or air under pressure; a two-way cock is so arranged that the gas is used for forcing the liquor from the drum when the outlet cock is opened. The claims are two, for the apparatus as described.—C. C. H.

Making Fodder from Distillers' Wash. Jasper Wetter, London. Eng. Pat. 6768, April 24, 1884.

The wash is submitted to the action of a spray of glue or gelatine solution, which carries down most of the nutritious matter. The precipitate is allowed to settle, the supernatent liquid run off, carbonate of lime is added to the residue nearly to neutralisation, which is completed by sodium bicarbonate, and the neutralised mass is raised by an elevator and caused to flow down over the surface of heated rollers, and then over an endless drying band until sufficiently dry to be ground by crushing rollers. The roller drying apparatus, and the means of heating it, are claimed as well as the process.—J. M. H. M.

Utilisation of Hops in the Manufacture of Intoxicating Beverages otherwise than Beer. Max Hedicke, London. Eng. Pat. 7478, May 9, 1884.

The object of this patent is the preparation of a hop-liquer. The extract may be made by maceration, digestion, distillation, or a combination of any such processes without materially affecting the result. The patentee prefers to proceed as follow:—7lb. of hops are macerated in 60 quarts of spirit 7° over proof, and after twelve hours the extract is removed; the partially spent hops are then distilled with 40 quarts of spirit, and the distillate mixed with the extract first obtained. Brandy or whisky, etc., and sugar and water, are then added according to taste. The process of manufacture as described is claimed.—C. C. H.

A Novel Non-alcoholic Drink. T. F. Wilkins, Chiswick. Eng. Pat. 83, January 2, 1885.

This specification describes the preparation of three different liquors for consumption as beverages composed of infusions or decoctions of kola nut roasted, maté, coca leaves, and hops. Different proportions of the various ingredients are used according to the circumstances of the intended consumption. The claims are: (1) For a beverage composed of the decoctions described, with the addition of a small quantity of salicylic acid; (2) a similar beverage, but with the omission of the decoction of hops.—C. C. H.

XVII.—PRESERVING FOOD, MEATS, Etc.

Arresting or Preventing Fermentation. F. S. Barff, Middlesex. Eng. Pat. 5096, March 18, 1884.

Fruit or vegetables are heated with or without water to a temperature somewhat under the boiling point, and from 2 to 4 per cent. of boroglyceride is added. Two per cent. of boroglyceride added to weak wines prevents the second fermentation, and enables them to bear transportation as well as the stronger wines.—J. M. H. M.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

Apparatus for Use in the Process of Softening and Purifying Water. W. Wyatt. Eng. Pat. 6213, April 10, 1884.

The apparatus is to be employed for the purpose of mixing lime-water or other liquid or liquids for use in the said process, or for mixing such liquids with lime or other solid matters. A hollow standard, capable of revolution on its axis, and provided near its bottom with a hollow perforated arm standing out at right angles, is placed in a tank, preferably near the floor, so that the apparatus may be immersed in the materials to be acted upon. At the top of the standard is an arrangement by means of which a stream of water can be injected under pressure, together with a quantity of air drawn in through apertures. The air and water pass down the hollow standard and along the arm until they reach the perforations, through which they escape, causing a more or less violent agitation of the liquid by which the arm may be surrounded. The apparatus may be placed in the centre of a tank, or two or more of them may be placed in one tank, motion being given to them by suitable contrivances. In place of a stream of water under pressure, air may be forced from a pipe through the hollow standard. —E. G. C.

Improvements in Apparatus for Use in the Treatment of Sewage and in other Operations in which Solid Matter is required to be Added to or Mixed with Fluid Matter in Certain Relative Proportions. S. K. Page, C. E. Robinson, and W. Stevens. Eng. Pat. 7198, May 3, 1884.

According to this invention, the flow of the sewage or other fluid, to which the solid matter is to be added, or with which it is be mixed, is caused to actuate apparatus by which the latter is supplied or by which its supply is controlled. The mixture of the solid and liquid matters is thus effected automatically. A vessel of the required form and size is mounted on pivots or trunnions, in such a position relatively to the mouth of a pipe from which the fluid issues, that the fluid so issuing will pass into the vessel. The latter is counterbalanced in such a manner that, when it has received a certain quantity of fluid, it turns on its pivots or trunnions and discharges the fluid received; it then returns to its original position and is ready to receive another charge of the fluid. Above the vessel is mounted a hopper containing the solid matter to be mixed with the fluid, and provided in its lower part with slides or valves, one above the other, and at such a distance apart that the space enclosed between them will hold the quantity of solid matter required for each charge of the sewage or other fluid. These slides or valves have openings in them to permit of the passage of the matter from the hopper when the openings are brought within the mouth of the latter, and they are so connected with the vessel already described that, when it turns on its pivots to discharge its contents, they slide in one direction, the lower valve closing the mouth of the hopper and the opening in the upper valve being brought within the hopper. On the vessel returning to its original position, the upper valve is closed and the opening in the lower one is brought within the mouth of the hopper. The matter previously enclosed between the two valves thus falls into the mounted vessel. The capacity of the lower part of the hopper between the two slides or valves can be increased or diminished as may be required.—E. G. C.

Preventing the Emission of Metallic Vapours, Compounds of Metals, Sulphur Dioxide, or other Vapours from the Chimneys and Flues of Chemical, Metallurgical, or other Works. E. H. Cook. Eng. Pat. 7731, May 15, 1884.

THIS invention consists in the use of sulphuretted hydrogen, alkaline sulphides, and mixtures of these for preventing the vapours given off from furnaces leaving the stacks, and thus getting into the atmosphere. The sulphur compounds are produced from alkali waste, and the modes of treating the waste are as follows: 1st, The substance is moistened with water, and air or steam blown through the mass. The gases escaping at the outlet are thus charged with sulphur compounds, and being brought into contact with the gases or vapours given off from furnaces, chemical changes occur, resulting in the deposition of the metals present as sulphides, and also in the decomposition of the sulphur dioxide, sulphur being deposited. 2nd, The waste having been mixed with water, cloths are steeped in it, and these are suspended in the flues, etc., when similar changes will occur as before. 3rd, The waste is mixed with water, and the gases and vapours from furnaces are made to come into contact with the mass.—S. H.

An Improved Preparation of Carbon, Adapted Especially for Electrical and Filtering Purposes. S. J. Coxeter and H. Nehmer. Eng. Pat. May 22, 1884.

CARBON and peroxide of manganese, or any other substance capable of giving off oxygen, is mixed with silicate of potash or soda, so that the compound forms a pasty mass. After drying, it is immersed in a solution of an ammonium salt, or chloride of metals, or in any acid that will have the effect of decomposing the alkaline silicate, so that the silica be precipitated intimately amongst the particles of the carbon, and the other substances employed. The mass is then boiled in water, which dissolves out everything but carbon, peroxide of manganese, and silica. After this it is dried and fit for use, especially for elements in electrical batteries. The inventors term their finished product "Silico-carbon."
—S. H.

Improvements in the Purification of Water. W. Anderson. Eng. Pat. 5496, November 23, 1883 (Amended Specification dated May 23, 1884).

THIS invention relates to the treatment of water by means of spongy iron. According to the method at present adopted, the purifying material is arranged in layers, as in an ordinary filter bed, the disadvantages of this system being that the spongy iron, when used with bad water, becomes covered with slime and caked into lumps, that it has to be disturbed and cleaned from time to time, and that, "the process of purification by percolation being very slow, large areas of filters are required, and a heavy capital expenditure in the purifying material." The inventor proposes to place the spongy iron in a revolving vessel, mounted upon hollow trunnions, which serve as the inlet and outlet for the water. The vessel referred to is not nearly filled with the spongy iron, the particles of which must be free to be carried up on to shelves or ledges within the vessel, and to fall again through the water, fresh surfaces being in this way constantly exposed. The water operated upon flows continuously through the revolving vessel.
—E. G. C.

Apparatus for Disinfecting Rags and other Fibrous Materials. S. W. Parker and H. Blackman, New York. Eng. Pat. 16,539, December 16, 1884.

ACCORDING to this invention, rags and other fibrous materials may be disinfected while in the bale or package, and liquid or gaseous disinfectants can be caused to penetrate and permeate the mass of the bale in every direction. The disinfecting chamber in which the operation is to be carried out, is furnished with a series of five or more rotary, tubular, perforated screws, which, by means of suitable gearing connected with them, and also with a car upon which each bale in succession is brought into the chamber for treatment, are caused to penetrate the bale to the distance of their full lengths. The hollow interiors of these perforated screws are connected with a separate chamber or receptacle, into which is forced in any desired way a disinfectant, either in the form of gas or liquid. The disinfectant employed passes through the hollow screws and perforations therein, and permeates the whole mass of the bale of rags, etc. When the bale has been subjected for a sufficiently long time to the action of the disinfectant, a stream of pure air can be forced through the screws to drive all noxious gases from the interior of the bale and surrounding chamber. Immediately above the disinfecting chamber is a tank containing a disinfecting liquid, through which all gases and vapours must pass before escaping into the air. Each bale, after having undergone the purifying process, can be withdrawn from the chamber by shifting the driving belts, and so reversing the direction of the rotation of the driving gear connected with the tubular screws and car already referred to.—E. G. C.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in Bleaching Paper Pulp. J. H. Johnson, Middlesex. From Jean Baptiste Fessy, France. Eng. Pat. 7511, May 9, 1884.

HITHERTO the bleaching of materials for paper-making, and the bleaching of other materials, has been effected by immersion in baths of different kinds, whereby there results a considerable loss of the bleaching agents, owing to the large quantities required for immersing the materials. This invention has for its object to effect economy in the cost of bleaching by reason of the small quantities of bleaching agent required, and also to save time, "owing to the rapidity with which the process can be performed by applying the decolourising or bleaching agents in a nascent condition."

The bleaching is to be effected by acting on the materials to be bleached with the solution of the bleaching agent in the form of spray, which may be produced by the action of steam or compressed air. It is proposed to employ for this purpose an apparatus similar to "Körting's Pulveriser," but constructed as described in the drawings accompanying the specification, which should be consulted for details.

"This system of bleaching can be readily applied by utilising the apparatus ordinarily employed in paper-mills, and requires no special skill or training on the part of the workmen. The effect produced on the materials is permanent; and paper pulp, usually very difficult to bleach, can be bleached with rapidity, the operation lasting from a few minutes to a few hours, according to the nature of the materials. Pulp which, owing to the chemical nature of the colour or the mechanical condition of the materials (*e.g.*, wood pulp), hitherto could not be bleached in a practically available manner, can be successfully treated by means of this proce s; and facility is also given for obtaining an absolutely regular and uniform bleaching, to any desired tint or degree, as the chemical and mechanical action can be arrested at any desired stage." Inventor may use as a means of pulverising any other chemical or mechanical agent; and any bleaching agent may be employed. A saving of 60% in bleaching powder is claimed by the patentee.
—H. A. R.

Improvements in the Manufacture and Subsequent Treatment of Sensitive Paper for Copying Drawings, Documents written on one Side, and the like, by Photography. H. J. Shawcross. Eng. Pat. 8771, 1884.

THIS invention has for its object the obtaining of exact copies of line drawings or photographs on sufficiently translucent paper in black lines, or in some cases of coloured lines, on a white surface, and consists in spreading on the surface of the paper two chemicals, one of them very sensitive to light, and both capable, when combined, of colouring the paper. The inventor uses, for the sensitive solution, a mixture of per-chloride of iron,

gelatine, ferric sulphate, sodium chloride and tartaric acid; for the developing material, powdered tannic acid. The surface of the paper is first covered with the sensitive solution, thoroughly dried, and the developing material is then rubbed or pressed in. In using paper prepared in this way, the tracing must be laid over the sensitive surface and exposed to light in a glass frame. After some time the paper is taken out, laid on the surface of water, wetted on both sides, well washed and dried, when it will contain an exact copy of the original tracing. If a deep blue be required, ferrocyanide of potash can be used instead of tannic acid; if a deep red be required potassium thiocyanate may take its place; catechu will give a green.—S. H.

Improvements in Treating Vegetable Substances in order to obtain Fibrous Materials for Textile Purposes, and Pulp for Making Paper, and for other Useful Applications. Thomas Graham Young and John Pettigrew, jun. Eng. Pat. 14,735, November 8, 1884.

THE process consists in treating wood or other vegetable substances with a 20 per cent. solution of nitrous acid, preferably at a boiling temperature. The disintegrated wood is then washed and treated with a solution of caustic soda or other alkali or alkaline earth, with or without pressure. The pulp, after washing, can then be bleached in the ordinary way. The oxides of nitrogen produced in the first part of the process can be recovered by leading them into a tower, where they are acted upon by air and steam.—E. J. B.

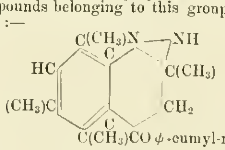
Improvements in Treating Vegetable Substances in order to obtain Pulp for Making Paper, and for other Useful Applications. Thomas Graham Young and John Pettigrew, jun. Eng. Pat. 14,988, November 14, 1884.

THIS process is similar to the above, nitric acid or nitric acid containing nitrous acid being substituted for the nitrous acid.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On Derivates of ψ-cumylquinizine. S. Haller. Ber. **18**, 706.

THE derivatives of cumylquinizine can be prepared in the same manner as Knorr's quinizines (*Ber.* xvi. 2597, and xvii. 546 and 2032), with which they also agree as regards reactions and properties. The constitution of the compounds belonging to this group can be represented, thus:—



ψ-cumyl-methyl-oxyquinizine.

The most characteristic compound is ψ-cumyldimethyl-Oxyquinizine (ψ-cumylantipyrine) obtained by heating in a sealed tube ψ-cumylmethyloxyquinizine with methyl iodide and methyl alcohol, from four to five hours, at 100° C. Its reactions are very peculiar. Its aqueous solution is coloured red with iron perchloride. Nitrous acid produces a bluish green colouration, owing to the formation of isonitroso-ψ-cumylantipyrine. It dissolves with a deep red colour, in cold concentrated nitric acid, which contains no nitrous acid. On adding water the nitro-derivative is separated as a pink crystalline mass.—S. H.

Brucine. O. de Coninck. Compt. Rend. **99**, 107.

ON fractionating the distillate obtained by heating cinchonine or brucine with potash, tetrahydroquinoline is formed. It is an oil of high refractive power, and possesses the smell of quinoline and indol. Tetrahydroquinoline is, therefore, present in the molecule, both of cinchonine and brucine.—J. B. C.

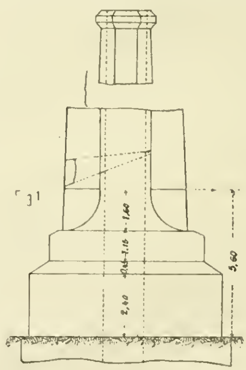
Improvements in the Manufacture of Salicylic Acid. W. Lloyd Wise. From Chemische Fabrik vormals. Hofmann and Schoetensack, Ludwigshafen. Eng. Pat. 3723, November 19, 1884.

CHLORO-CARBONIC acid (carbonyl chloride or phosgene gas) is passed into a dry-heated powdered mixture of 30gs. phenol and 40gs. caustic soda, which is agitated mechanically, and heated gradually from 140° C. to 200° C. The operation is continued till 90 per cent. of the phenol has been converted. The residue is dissolved in water, heated with acid, the phenol driven off by steam, and the salicylic acid precipitated from the sodium salicylate in the usual way. The claim is for causing chloro-carbonic acid (carbonyl chloride) to act as above stated upon dry powdered heated mixture of phenol and an alkali.

XXI.—EXPLOSIVES, MATCHES, Etc.

The Removal of Erections by means of Dynamite. Dingl. Polyt. J. **254**. 456.

THE plan adopted and found successful at Aszod for the removal of a chimney shaft by means of dynamite is described in *Mittheilungen über Gegenstände des*



Artillerie- und Geniewesens, 1884, p. 215. In Fig. 1 the details of construction of the shaft are shown; the height was 59·6m. At a height of 6m. above the ground a wedge-shaped hole, 1m. high at its widest end, 0·20m. at

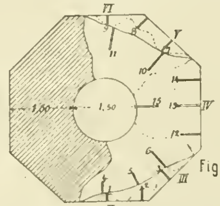


Fig 2.

its small end, was blasted out, and the chimney fell towards the side in which this cavity was made. In Figs. 2 and 3 the position of the bore-holes is shown, and the following table gives the amount of dynamite No. 2

used in each hole. The charges were exploded in series, I., II., III., IV. :—

Group	No.	Depth		Charge	
I.	No. 1.	0·20m.	deep ...	0·04k.	charge.
	2.	0·25	,, ...	0·07	,,
	3.	0·30	,, ...	0·11	,,
II.	4.	0·25	,, ...	0·06	,,
	5.	0·30	,, ...	0·11	,,
	6.	0·50	,, ...	0·50	,,
III.	7.	0·40	,, ...	0·25	,,
	8.	0·30	,, ...	0·11	,,
	9.	0·25	,, ...	0·06	,,
	10.	0·55	,, ...	0·50	,,
	11.	0·55	,, ...	0·40	,,
IV.	12.	0·50	,, ...	0·50	,,
	13.	0·60	,, ...	0·80	,,
	14.	0·50	,, ...	0·50	,,
	15.	0·53	,, ...	0·60	,,

The charges in the holes 6, 10, 11 were made sufficiently heavy to cut through the brickwork ; the shots of group IV. effected the final displacement, being fired simultaneously. The work occupied in all three days, and

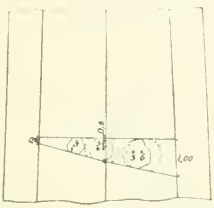


Fig 3

required 4·61k. of dynamite, 15 detonators, 10·2m. of Bickford and 8m. lead fuse. The total cost was 70 marks. Of the 250,000 bricks in the shaft, 150,000 were quite serviceable, and other 20,000 still useful.—W. D. B.

Improvements in Match-making Machinery. Dingl. Polyt. J. **255**, 239.

A MACHINE to obviate the necessity for hand-labour in the dipping or heading of matches has been patented by

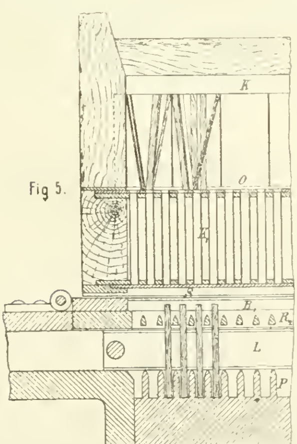


Fig 5.

Holmström (Ger. Pat. No. 25,788, June 30, 1883). To obtain good heads it is not sufficient simply to dip the ends of the splints into the melted composition, but the splints require to be moved about. In the machine patented the arrangement is such that the splints, in the usual carrying frame suspended on an endless band, are led over and pressed by means of a spring upon three or more drums or cylinders dipping into the composition, which, by the revolution of the cylinders, is brought to

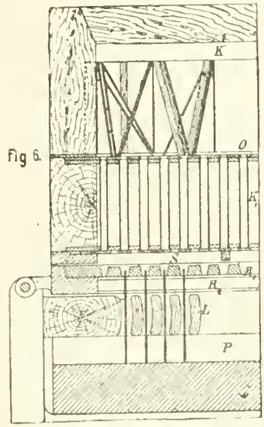
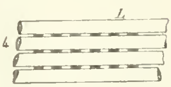


Fig 6.

the ends of the splints. The heads are obtained round and uniform by placing the cylinders at an angle with the line of motion of the carrying frame ; the composition is thus pressed against two adjacent sides of the quadratic splint by every drum. A machine for filling flat splints into carrying frames for dipping has been patented by Sebold (Ger. Pat. No. 26,937, July 11, 1883), and is a

Fig 3

Fig 4



modification of that devised by the same for the purpose of filling the frames with oval, round, and quadratic splints. The box K (Figs. 5 and 6) is divided into a number of compartments, and rests upon the tube-box K_1, upon the top O of which the splints rest. This top O has perforations corresponding in position with the tubes of

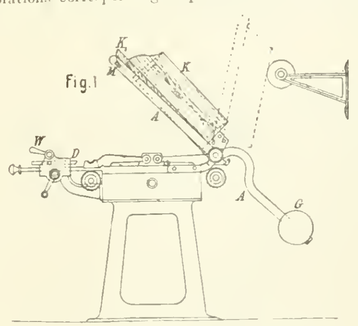


Fig. 1

K_1, and shaped as shown in Fig. 3, the third form being found most advantageous. The greater diameter of these openings is parallel to the laths L. The tubes of K_1 are filled by shaking the box K, the perforated slide S is brought into such position that the splints from K_1 fall through the perforations, then through the grid R with

narrow openings parallel with L, pass through a second grid R_1, the openings of which are at right angles with those of R, and by this guiding arrangement can be easily and correctly placed between the laths of the carrier, their ends resting in the grooves of P. If the boxes K and K_1, together with the slide S^1 and the grid R_1, be lifted up, the carrying frame may be tightened up in the usual manner and removed from the machine. The surface of the carrier has the appearance shown in Fig. 4. To facilitate the opening and closing of K and K_1, and

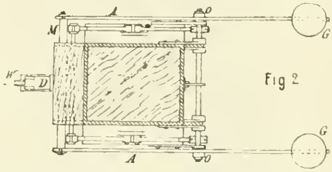
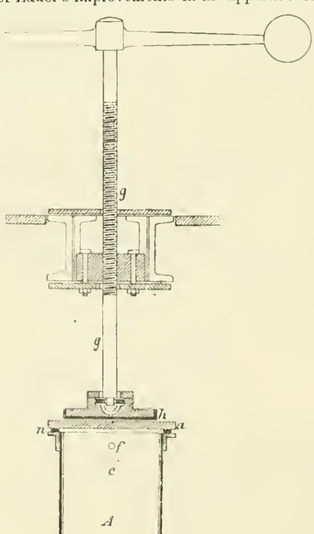


Fig 2

the shaking of K, there are two levers (Figs. 1 and 2) on either side of the machine, turning around a fixed axis O, provided with counterweights G and connected at the other end by M. The boxes also turn round O, and resting upon M, are moved by the levers. By means of a bolt D fixed in position by the bent lever W, the cross-bar M can be held down, and the boxes K and K_1 being rendered independent of the weights G, can then be readily shaken.—W. D. B.

Improvements in the Manufacture and Application of Explosive Substances. Dingl. Polyt. J. **255**, 518.

A DETAILED description, with illustrations, is here given of Lauer's improvements in his apparatus for sub-



marine blasting with unconfined charges (Ger. Pat. 30,242, May 6, 1884; see also *Journ. Soc. Chem. Ind.* iii. [3], 193).

Ballabene prepares a plastic dynamite named lignite by absorbing from 80 to 85 parts of nitroglycerin with from 20 to 15 parts of a nitrocellulose obtained by the nitration of wood-flour. The apparatus shown in the figure is employed for the nitration of the wood. The vessel A is lined with lead, and has a false bottom consisting of two perforated plates, *c* and *b*, between which there is a layer of gun-cotton. The nitration acids, consisting of 62 parts of nitric and 142 parts of sulphuric acid, are introduced into A, *d* being closed, the wood-flour immersed therein, the lid *a* screwed down by *g* to form by aid of the washer an air-tight covering, and after a short space of time *d* opened and about 50 per cent. of the mixed acids expelled by the introduction of air at 2 atmospheres' pressure at *f*. After a short digestion the acids are squeezed out as far as possible by the press *g h*, and the nitrated pulp washed with water. It is to be noted that no arrangement for cooling is applied.

The Societé Anonyme des Poudres et Dynamites proceed according to Lanfrey and Renard's patent in the manufacture of a dynamite with active absorbent, named Paléine. Five qualities, A to E, are issued, of which A contains 40 to 50 per cent. of nitroglycerine, and 60 to 50 per cent. of nitrated straw. A is said to be about ⅓, B about ¼, and C slightly more powerful than ordinary 75 per cent. Kieselguhr dynamite.

Dolliak contributes his observations upon the properties of straw nitrocellulose (nitrated straw). Rye straw boiled 15 hours in a 1·2 per cent. solution of soda was nitrated and washed. The product matted together, possessed a brownish yellow colour, contained 11·07 per cent. of nitrogen, and when gradually heated flashed at a temperature of 177°. Exposed to a current of dry air at 60°, signs of decomposition were evident in three minutes.

Guttmann contributes a report upon the explosives manufactured in the Austro-Hungarian Empire. The following is a list of all the blasting compounds at present manufactured, and with the exception of No. 11 the composition of each is given in the original paper :—(1) Black gunpowder, (2) diorrexin, (3) haloxylin, (4) petralite, (5) janite, (6) carboazotine, (7) azotine, (8) amidogène, (9) lederite, (10) vulcanite, (11) myline. In the second series are (1) Nobel's new dynamite, Nos. 1 to 3; (2) white dynamite, Nos. 1 and 2; (3) rhexite, Nos. 1 to 5; (4) Arlberg dynamite, Nos. 1 to 3.

Several instances of the spontaneous inflammation of sponges employed for the cleansing of vessels which had contained nitroglycerin, have recently occurred in several factories where it was the practice to wash the sponges after use in tepid water, then in dilute soda, and dry. It is recommended to lay the sponges immediately after use in water, cleansing them ultimately by soaking in dilute hot soda solution, wringing out several times, and only, after this, to permit them to dry.—W. D. B.

The Manufacture and Application of Explosive Substances. Dingl. Polyt. J. **255**, 337.

NORDENFELT and Meurling (Ger. Pat. No. 30,676, Aug. 21, 1884) prepare a carbonaceous substance by subjecting cotton or wood cellulose, loosely packed in a vessel, to the action of a stream of hydrochloric acid gas. The cellulose soon becomes friable, and when the process has been carried sufficiently far, the hydrochloric acid gas is expelled by passing a stream of air. The carbonaceous substance obtained is impregnated with the requisite amounts of sulphur and potassium nitrate, by treatment with solutions of these substances respectively in carbon bisulphide and water; the powder mixture obtained by the evaporation of these liquids is manipulated in the usual manner.

Nitro-compounds for explosive purposes, one in the solid, the other in the fluid condition, are prepared by Gilles (Ger. Pat. No. 27,969, April 14, 1883) by the nitration of molasses. To obtain the solid compound, the molasses, without further preparation, are mixed with the nitrating mixture, the whole thrown into water, and the precipitate washed first with cold then with warm water. To obtain the liquid compound, the patentee

advises the nitration of moist molasses of such ultimate composition, that the ratio of carbon to oxygen—taking the oxygen of the water into account—shall approximate 2 : 3. According to Gilles, the liquid nitro-compound is yellow, boils when heated gradually between 180° and 200°, and detonates between 220° and 250°.

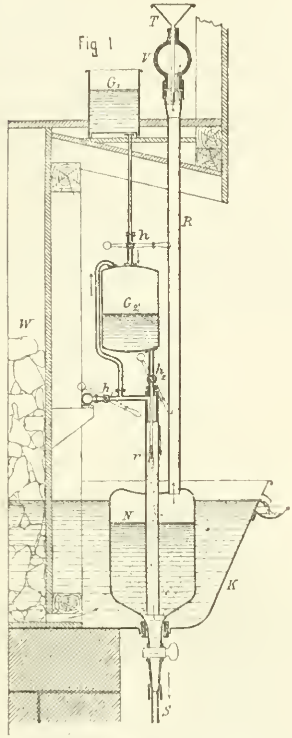


Fig 1

An apparatus for the preparation of nitroglycerine, patented by Schroeder (Ger. Pat. No. 29,130, December 28, 1883), presents few novel features. An arrangement, by which the glycerine sprayed by means of compressed

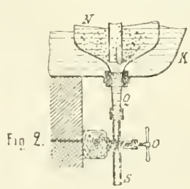


Fig 2.

air was introduced at the bottom of the nitration vessel, was described by Kurtz in 1879.

The following independent analyses of samples, taken from the same bulk of a consignment of Himly's powder, point to the difficulty of properly incorporating the coal-tar pitch with the requisite oxidising salts. One hundred parts of the powder gave to three analysts widely differing results:—

	1.	2.	3.
Potassium chlorate	45·50	33·50	62·50
Potassium nitrate	34·38	48·78	25·00
Coal-tar pitch	20·12	17·72	12·50

—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Separation and Estimation of Methyl- in presence of Ethyl-alcohol. C. de Poncy. Dingl. Polyt. J. **254**, 500.

THE method is based on the different solubilities of the oxalic ethers prepared from oxalic acid in presence of HCl—methyloxalate being easily soluble, ethyloxalate difficultly soluble in water; further, on the insolubility of the amide in water, formed by the action of ammonia upon the ethers.—J. B. C.

Quantitative Determination of Phosphoric Acid in Superphosphates. C. Mohr. Zeits. Anal. Chem. **23**, 487.

THE author finds that the method for directly determining the amount of soluble phosphate in commercial "supers" by the ammonium citrate method does not give exact results if the citrate solution is precipitated at once by magnesia mixture, a considerable quantity of phosphoric acid remaining in solution.

The new method is as follows: 5grm. of the superphosphate, or artificial manure, is treated in a mortar with hot water, and filtered into a ½-litre flask. After extracting three times in this way the insoluble portion is collected in a flask, and digested with 25cc. of an alkaline solution of ammonium citrate for one hour at 60-70°. The alkaline solution is filtered into the first portion, washed, and filled to the mark. If not acid, it should be previously acidified slightly with nitric acid.

To 10 to 20cc. of this solution an equal volume of fuming nitric acid is added, and a large excess of molybdate solution. The whole is digested an hour at 85° on the sand-bath. After cooling, it is filtered, the yellow residue dissolved in ammonia, again filtered, and precipitated with magnesia mixture. The precipitate is either weighed or titrated with uranium solution. The results of analyses by this method agree well with those calculated by difference—*i.e.*, by subtracting the phosphoric left undissolved in ammonium citrate from the total phosphoric acid in the sample—whereas the numbers obtained by the old direct method are in every case about two per cent. too low.

Another advantage of this method is that it can be employed in the case of all manures in which magnesia is present.—J. B. C.

Precipitation of Manganese with Bromine. C. Holthof. Zeits. Anal. Chem. **23**, 491.

THE author's method of precipitating manganese with bromine in presence of ammonia and ammonium chloride is a modification of that of Wolff (*Zeitschr.* 22, 520). It is as follows: If iron be present, it is first precipitated with ammonium carbonate, and the filtrate acidified. The solution is then diluted, so that about 1dgrm. of Mn is contained in ½ litre of liquid. Bromine is gradually added in the cold, until the solution is distinctly red. A large excess of *concentrated* ammonia is added, when the peroxide at once falls down. The solution is heated and filtered. The filtration is done by the pump, and the damp filter transferred to a platinum crucible, dried, and ignited. If only Fe is present the operation is a simple one. With small quantities of CuO, CaO, and MgO, the method gives good results. BaO, CuO, and ZnO may be previously eliminated. In presence of the alkaline earths, peroxide of manganese carries down a quantity of these oxides, as also of the alkalis, CuO, ZnO, and MgO. This error may be partly avoided by re-dissolving the precipitate in HCl, and precipitating with $(NH_4)_2CO_3$; but the separation is not

complete, especially when large quantities of CaO are present.

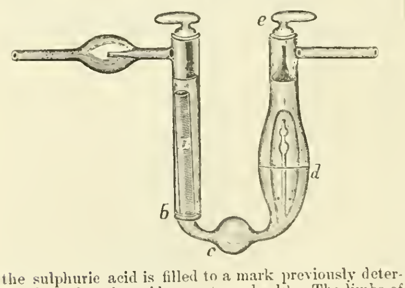
When, however, NH_4Cl is added, and after precipitation, the solution heated, these oxides, if present, are re-dissolved as double chlorides. ZnO and BaO are best separated first. CuO may be determined in the filtrate from MnO_2. If relatively large quantities of CaO and MgO are present, it is necessary to re-dissolve the first precipitate in dilute nitric acid, with a slight excess of formic or oxalic acid to prevent reduction. The excess of organic acid is then destroyed by the addition of a crystal of $KClO_3$, and the solution concentrated. By a further addition of $KClO_3$ the manganese is completely precipitated as MnO_2.—J. B. C.

Fusion Reagent for Silicates. C. Holthof. Zeits. Anal. Chem. **23**, 498.

THE author recommends sodium bicarbonate, 12-15 parts of which are used with the finely-pulverised silicate, a portion being placed at the bottom of the crucible and another portion mixed with the silicate. The crucible is then heated below fusion heat for a short time, and finally the mass is allowed to fuse quietly.—J. B. C.

Substitute for Calcium Chloride Tube. S. Schmitz. Zeits. Anal. Chem. **23**, 515.

THE construction of the apparatus is shown in the diagram. At *b* a piece of platinum gauze is placed, upon which rests a stick of glacial phosphoric acid. The limb *d* contains strong sulphuric acid, and is furnished with an arrangement similar to that of Schrötter's desiccator



(the sulphuric acid is filled to a mark previously determined, so that the acid cannot run back). The limbs of the tube are closed by hollow ground stoppers, smeared with a solution of gutta-percha in heavy petroleum. The stopper at *e* is furnished with a conical tube *g*, which prevents bubbles of sulphuric acid being carried away. The bulb *c* retains any liquefied phosphoric acid.—J. B. C.

Titrations with Potassium Permanganate Solution. W. Lenz. Zeits. Anal. Chem. **24**, 34-41.

PERMANGANATE solution, when used for estimating organic substances in water, is untrustworthy, since only those bodies which are very easily oxidised are completely burnt up to carbonic acid. With grape sugar, great discrepancies were noticed ; the greater the excess of permanganate, the greater the amount used. In no case, however, was the theoretical quantity of permanganate reduced, although about five times the calculated quantity was added. The experiments were repeated by varying the amount of grape sugar added to a constant quantity of permanganate solution, and then boiling for ten minutes, but with similar discordant results. With glycerine the experiments yielded results still further from the truth. The grape sugar never used more than 54 per cent. of the theoretical quantity of permanganate, and the glycerol (glycerine) never more than 34 per cent. under like conditions. The permanganate process is, therefore, useless for either absolute or relative estimations of organic matter. With decinormal permanganate and glycerine equally unsatisfactory results were obtained. With oxalic acid and strong alkaline permanganate solution $\frac{1050}{1000}$ normal, containing 40grm. of KHO to the litre, after twenty-four hours before titrating back, 2 out of 9 experiments were near the truth. The best results were those obtained when twice the theoretical quantity of permanganate had been employed. The oxalic acid solutions used for titrating permanganate should be freshly prepared, as the author finds that centinormal acid loses 15 per cent. of its strength in one week, when exposed to diffused daylight. Normal solutions will keep in the dark if stored in full bottles. Centinormal solutions, even in the dark, lose strength after a few weeks. The addition of 10grm. of boracic acid per litre prevents the decomposition of the oxalic acid, and does not impair its value for titrating purposes. It is best, therefore, to keep decinormal acid containing 1 per cent. of boracic acid, and dilute it as required. —S. R.

Funnel for Filtration in Absence of Air. F. Allihn, Zeits. Anal. Chem. **23**, 517.

THE arrangement of the apparatus is given in the diagram. The funnel has a cylindrical rim 1·2cm. high, covered with a lid provided in the centre with a neck. Into this fits a cork and bent glass tube. The funnel is fitted into a filter flask, which has a side tube. By con-

necting the tube of the funnel with that of the flask by a piece of indiarubber tubing, the exterior air is excluded. In case a particular gas is required, the funnel is then provided with a double-bored cork. Through one opening the gas is introduced, and it passes out by the other, a connection being made with the filter flask as before.—J. B. C.

Method for Estimating Nitric Acid Volumetrically. A. Longi. Zeits. Anal. Chem. **24**, 23-26.

STANNOUS salts destroy the blue colour produced by diphenylamine in solutions of nitric acid. The stannous solution employed is made by dissolving 40grm. of potassium stannous sulphate (Marignac) in 800cc. of water, then adding an equal volume of dilute sulphuric acid, and a little concentrated hydrochloric acid. The solution is then titrated, and diluted with weak sulphuric acid, till decinormal. The accuracy of the method depends on the amount of sulphuric acid present. From numerous experiments, the author shows that when 3·5 volumes of concentrated sulphuric acid are added to each volume of the solution to be tested before titrating, the method is quite accurate. Large quantities of ferric salts prevent the application of this method. Concentrated solutions of nitrates should be diluted with water before adding the concentrated sulphuric acid, and in all cases the mixture should be cooled before adding the diphenylamine solution.—S. R.

A Thermostat of Simple Construction which can also be used as a Registering Thermometer. E. H. von Baumhauer. Zeits. Anal. Chem. **24**, 42-46.

AN ordinary glass cylinder A is connected with a cork, or, better, fused to a narrower glass tube B open at both ends, but drawn out at the lower extremity. To the

upper end a brass knee-piece is cemented. A round hole is bored in this brass piece immediately above the tube B, so as to allow of the passage of a long graduated tube C into it. The tube C fits air-tight by means of a well-greased leather washer, but can be raised or lowered to any desired height. The gas passes through this tube, and is shut off all but from a small hole in its side about 1½cm. from its lower end by the rising of the mercury in the tube B from the expansion of the air in the glass cylinder. The instrument is graduated by first removing the tube C, and immersing it in a bath at the maximum temperature for which it is required, and then whilst hot filling the tube B with sufficient mercury to prevent air being drawn into the air chamber on cooling. The tube C and the brass piece are next connected, and the gas passes in from the upper end of C, and out from the brass piece by the indiarubber tube Z. On gently heating, the mercury rises in the tube B, and nearly shuts off the gas from time to time as the tube C is raised, the division on the scale coinciding with the mark *m* at the different temperatures being noted. Fig. 2 shows how a fine adjustment can be adapted to the instrument in cases where small changes of temperature are important. In most cases, however, the regulation by hand is all that is needed. To make the instrument self-record the maximum temperature, a small plug of indiarubber is placed in the lower end of tube B which, whilst allowing

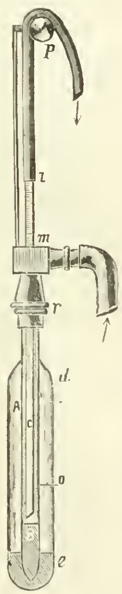


FIG. 1.

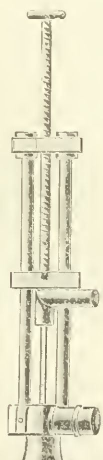


FIG. 2.

the mercury to rise freely as the temperature increases, prevents its return. The tube C, which is then connected by a pulley with a counterpoise, rises with the mercury, so that the final position of the scale gives the maximum temperature reached.—S. R.

Test for Citric Acid. C. Mann. Zeits. Anal. Chem. **24**, 201.

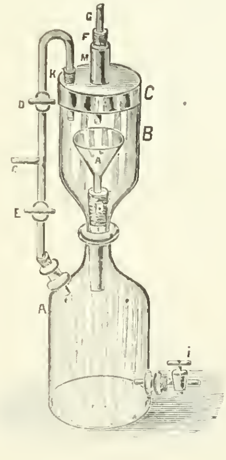
CITRIC acid mixed with glycerol and evaporated to dryness at a low temperature, yields a porous light yellow mass which becomes hard and brittle on cooling; but if treated whilst warm with water, becomes transparent, and has the appearance of swollen-up gelatin. The product is scarcely dissolved by water, ether and alcohol, but readily by alkalis on warming, and is acted upon by concentrated sulphuric acid. The alkaline solution, when concentrated, becomes pale green after some days. If the excess of ammonia be removed from the original solution and hydrogen peroxide be added, the green is produced at once. Fuming nitric acid gives also a green colour, which changes to a blue on warming. When using these reactions as a test for citric acid, the proportion of 1 part of crystallised citric acid to ·6 or ·5 of glycerol is found to be the best. Tartaric and malic acids give no similar reactions.—S. R.

Soap Analysis. A. Gawalovski. Zeits. Anal. Chem. **24**, 219.

IN estimating the fatty acids, the author decomposes with sulphuric acid, transfers to a folded filter, washes and shakes the filtrate and wash-water with light petroleum, separates, and then evaporates the petroleum portion; next he dissolves the fatty acids on the filter with light petroleum, and mixes with the first portion of the fatty acids before finally drying and weighing. The filter need not be dried before dissolving the acids in the light petroleum.—S. R.

Apparatus for Filtering and Drying very Oxidisable Precipitates. W. Bachmeyer. Zeits. Anal. Chem. **24**, 59-61.

THE apparatus is shown in the accompanying figure, and is constructed of glass with the exception of the cover C, which is of brass. The tube *g*, which is connected with the brass tube *m* by the cork *f*, is bent over and unites with a small flask containing the precipitate. This small flask has a cork with three holes, one for the tube *g*, a second for a glass funnel, and the third for a tube connecting with a gas generating apparatus. When



all connections are found to be air-tight the tube *c* is connected with a water pump and the cock *e* is opened, the precipitate is drawn over by lowering the tube *g* into the precipitate in the flask as soon as the apparatus is filled with the indifferent gas. The precipitate collects on the funnel *d*, and distilled water can be drawn over to wash the precipitate there, by pouring down the funnel in the small flask. By opening the tap *d* instead of *e*, the filtration can proceed more slowly, and this tap is also useful with very muddy precipitates. To dry the precipitate the cork *k* is replaced by another without an

opening, the glass tube *g* is fused off, and the upper part B of the apparatus removed from the lower part A, and transferred afterwards to a drying oven.—S. R.

A New Separation of Nickel and Cobalt. M. Ilinski and G. von Knorre. Ber. **18**, 699.

If an alcoholic or acetic acid solution of nitroso-β-naphthol be treated with a neutral or hydrochloric solution of cobalt, a bulky purple precipitate is obtained, which resists all action of alkalis, acids, oxidation or reduction. The precipitate is cobalti-nitroso-β-naphthol

$$[C_{10}H_6O(NO)]_2Co.$$

If a solution of nitroso-β-naphthol, in 50% acetic acid, or an aqueous solution of nitroso-β-naphthol sodium, be treated with a solution of a nickel salt, a brownish-yellow precipitate is produced, which is slightly soluble in water and alcohol. Hydrochloric and sulphuric acids deprive it very easily of its metal, leaving behind nitroso-β-naphthol, which remains in solution if sufficient acetic acid is present. If, therefore, an acetic acid solution of nitroso-β-naphthol be treated with little hydrochloric acid, and then with the solution of a nickel salt, no precipitate is produced. On these reactions the following method of separating cobalt from nickel compounds is based:—The solution containing these metals, as sulphates or chlorides, is treated with a few cc. of hydrochloric acid. The liquid is warmed, and a hot solution of nitroso-β-naphthol in 50% acetic acid is added in excess. The precipitate is allowed to settle, and after cooling the supernatant liquid is examined whether it gives a turbidity with a new addition of nitroso-β-naphthol solution. If the precipitation is complete, the precipitate is filtered, after some hours' standing, and washed at first with cold, then with warm 12% hydrochloric acid, until all nickel is removed, and at last with hot water. The filter is allowed to dry, and a few grammes of pure crystallised oxalic acid are added to it. It is then slowly burned in a tared Rose crucible, and the residue ignited in an atmosphere of hydrogen, when pure metallic cobalt is obtained. In the filtrate from the cobalt precipitate, after evaporating the bulk of acetic acid, the nickel can be quantitatively separated by the addition of potassium hydrate. But it is preferable to precipitate in a measured portion of the solution both cobalt and nickel, and, after reducing them in a hydrogen current, to weigh the metals. In another portion, the weight of cobalt is determined by the process as mentioned above, and the amount of nickel can then be estimated by difference. The authors give the results of several analyses, which prove the method very trustworthy indeed. It is also shown that the reaction is far more sensitive than Portman's process with potassium nitrite and acetic acid. Small quantities of cobalt can be determined very accurately when mixed with large quantities of nickel.

—S. H.

A New Method of Estimating Nitrogen, of General Application. Carl Arnold. Ber. **19**, 806.

The author proposes the following method of estimating nitrogen in inorganic and organic substances, with which he has obtained very accurate results with nitrates, nitro-compounds, azo-compounds, amido-compounds, etc. The method is based on the methods which have been already proposed by Tamm-Guyard (combustion with a mixture of soda-lime and sodium-hyposulphite), and by Ruffle (combustion with a mixture of soda-lime, sodium-hyposulphite, carbon and sulphur), but which do not give good results with all substances. It consists in heating the substance with a mixture composed of equal parts of soda-lime, sodium-hyposulphite, and sodium-formiate, the operation being performed like an ordinary soda-lime estimation. The combustion tube is charged with 12 to 15cm. of the mixture and substance, 15 to 20cm. of the mixture alone, and 5 to 10cm. of soda-lime, and heated to a moderate red heat. The operation should last about an hour, and at the termination air is drawn through for five minutes to clear out the last traces of the ammonia. In order to obtain good results, it is essential that the mixture should be packed tightly into the tube (by tapping it in an upright position) and not leave a channel along the top. The proportions of the reducing mixture can be varied considerably, and the sodium hyposulphite can be replaced by 10% of sulphur.

—A. G. G.

On a Colour Reaction of some Diketones. Eug. Bamberger. Ber. **18**, 865.

A few drops of aqueous caustic potash are added to a hot alcoholic solution of the diketone (air being excluded as far as possible); if a dull red colouration is produced, which vanishes on shaking with air, it may be concluded that the diketone used has its two CO groups adjacent. The absence of a colouration, however, is not a positive proof that the CO groups are not adjacent.—A. G. G.

New Books.

On Certain Indications of the Existence of an Allotropic Modification of Elementary Nitrogen, and on the Synthesis of Ammonia. By George Stillingfleet Johnson. London: J. & A. Churchill, 11, New Burlington Street, 1885.

This is an 8vo volume, bound in cloth, containing 32 pages of subject matter. The work is divided into four chapters, and is illustrated by three woodcuts. The chapters are headed as follows:—Chapter I. Historical Electro-chemical Researches. (i.) Direct Synthesis of Ammonia by means of the Silent Discharge. (ii.) Observations of MM. Dehérain and Maquenne, and of MM. P. and A. Thénard, on the Action of the Silent Discharge upon Water Vapour, and upon a Mixture of Nitrogen Gas and Water Vapour. (iii.) Action of the Electric Spark. Chapter II. Researches on the Synthesis of Ammonia from the Gas evolved by the action of Heat upon Solutions of Ammonium Nitrite. Chapter III. Further Experiments on the Nature of the Gas produced by action of Heat upon Solution of Ammonium Nitrite, conducted in 1883. Chapter IV. Experiments with Atmospheric Nitrogen.

The book contains mainly the subject matter of two papers published in the *Journal of the Chemical Society* of 1881, as well as that of three as yet unpublished papers.

Lessons in Elementary Practical Physics. By Balfour Stewart, M.A., LL.D., F.R.S., Professor of Physics, Victoria University, The Owens College, Manchester, and Mr. W. Haldane Gee, Demonstrator and Assistant Lecturer in Physics, The Owens College. Vol. I. General Physical Processes. London: Macmillan & Co., 1885. [All rights reserved.]

This small 8vo volume, bound in red cloth, and comprising besides Preface, Table of Contents, and a List of Tables, 291 pages of subject matter, is the first of three volumes, of which the remaining two, yet to follow, will treat respectively of "Electricity and Magnetism" and "Heat, Light, and Sound."

The work is illustrated by 103 well-executed woodcuts, and the concluding 33 pages of subject matter are usefully devoted to an Appendix, in which the following items receive attention: A. On the Selection, Conduct, and Discussion of operations suitable for the Physical Laboratory. B. Centimetre, Gramme, Second (C.G.S.) System of Units. C. Practical Notes.

As regards the matter in the body of the work, the arrangement, and to some extent the treatment of this, may be conceived from the chapter headings, which follow:—Chapter I. Measurement of Length. Chapter II. Angular Measurements. Chapter III. Estimation of Mass. Chapter IV. Measurement of Area and Volume. Chapter V. Determination of Density. Chapter VI. Elasticity, Tenacity, and Capillarity. Chapter VII. Determination of Atmospheric Pressure. Chapter VIII. Time, Gravitation, Moments of Inertia. Appendix.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

5119 H. E. Newton, London—Communicated by A. L. G. Dehne, Germany. Improvements in the method of and apparatus for purifying the feed-water for steam boilers. April 25

5310 J. Laidlaw, Glasgow. Improvements in centrifugal machines, otherwise known as hydro-extractors. Complete specification. April 30

5816 F. J. Austin and S. Low, jun., London. The prevention of the formation of boiler crust. May 12

5903 O. Imray, London—Communicated by H. B. Scott, France. An improvement in filter presses. Complete specification. May 13

6053 E. Burton, London. Improvements in furnaces for the combustion or destruction of refuse. Complete specification. May 16

6065 W. P. Thompson, Liverpool—Communicated by A. Buttner and C. Meyer, Germany. Improvements in concentrating aqueous solutions and the like, and in drying the resultant products, and apparatus therefor. Complete specification. May 18

6066 W. Weldon, Burstow, Surrey—Communicated by A. R. Pechiney et Cie, France. Improvements in apparatus for cooling gases and vapours.

II.—FUEL, GAS, AND LIGHT.

5413 F. Leslie and J. A. Wanklyn, London. Improvements in the treatment of gas and in the materials and apparatus employed therein. Complete specification. May 2

5638 F. Lennard, Westminster. Improvements in apparatus for converting oils into gaseous fuel, and in its application to the heating of boilers, stills, and other similar plant. May 7

5645 C. Marquis de Montgrand, London. A new or improved process and apparatus for the production at will of heat and cold, dry or moist, by the compression and rarefaction of the air or of gases. Complete specification. May 7

5955 F. Snelling, London. Improvements in artificial fuel. May 14

5980 A. Wilson, London. Improvements in gas producers. May 15

6059 J. McNair, Glasgow. Improvements in furnaces of retort chambers used in gas manufacture, and in means for supplying heated air thereto. May 16

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

5002 H. Simon and W. Charlton, London. Improvements in hydraulic mains and valves for conducting gases and other products of distillation from coke-ovens, gas-retorts, gas-producers, or other apparatus for the distillation of carbonaceous substances. April 22

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

4953 E. de Pass, London—Communicated by F. Kugelmann, France. A process of heating and utilising the fruit of the Mauritia vinifera or Mauritia flexuosa to render it fit for industrial purposes. April 24

5512 B. Hallett and T. F. Wiley, London. A new or improved method of applying water-proofing material to pile and other goods. May 5

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

4979 J. Hebblewaite and E. Holt, Manchester. Improvements in means employed for the production of designs on textile and other fabrics or surfaces. April 22

5410 J. K. Kaye, Halifax. An improved method of dyeing a fast yellow colour on cotton and other vegetable fibres.

5782 O. Imray, London—Communicated by The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Process for printing textile fibres by means of laevulic acid. May 11

6018 T. J. Hutchinson, Bury. An improved method of preparing waste for bleaching purposes. May 16

6057 W. Stewart, Glasgow. Improvements in calico-printing machines. May 16

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4902 A. Neilson and J. Snodgrass, Glasgow. Improvements in obtaining ammonia in connection with the distillation of oil-yielding or carbonaceous minerals. April 21

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5920 J. F. Chance, Liverpool. Improvements in the purification of the alkaline lees known as tank or vat liquors. May 14

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6066 W. Weldon, Burstow, Surrey—Communicated by A. R. Pechiney et Cie, France. Improvements in apparatus for cooling gases and vapours. May 18

VIII.—GLASS, POTTERY, AND EARTHENWARE.

5012 R. Clark, Longport, Staffordshire. Improvements in machinery for batting potters' clay. April 23

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5354 E. Robbins, London. The novel manufacture of a new decorative concrete of slag combined with similar and other materials. April 30

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5538 P. Walker, Glasgow. Improvements in making lithographic stones, baths, washing tubs, sinks, and other articles of Portland cement. Complete specification. May 5

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4909 G. A. Jarvis, London. Utilisation of basic slags. April 21

4925 L. Roberts, D. Roberts, and J. Colquhoun, Sheffield. Improvements in furnaces and appliances connected therewith for smelting, puddling, refining, heating, or otherwise treating minerals, metals, and the like substances, such improvements being likewise applicable to other classes of furnaces. April 21

5003 W. Cochrane, London. An improvement in moulds for cooling and discharging slag. Complete specification. April 22

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5973 C. H. McEwen, London. Improvements in the manufacture of metallic antimony. May 15

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5996 T. Jack, jun., Glasgow. Improvements in treating aluminous iron ores to adapt them for smelting. May 15

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6039 J. Heath and W. Frost, London. An improved method of blasting and shot firing in mines. May 16

6048 H. Aitken, Glasgow. Improvements in the treatment of carbonaceous, bituminous, calcareous, and other substances, such as ores, in order to obtain products therefrom. May 16

6075 J. B. Jackson, London. Improvements in and apparatus for hardening or tempering articles of sheet steel. May 18

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5359 W. R. Lake, London—Communicated by J. B. Dupret, Belgium. Improvements in and relating to impermeable and preservative compositions for use in the preparation of leather, and for other purposes. Complete specification. April 30

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6031 J. Duncan and B. E. R. Newlands, London. Improvements in centrifugal apparatus for use in the refining of sugar. May 16

6032 J. Duncan and B. E. R. Newlands. Improvements in moulds for use in the refining of sugar. May 16

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4956 W. R. Lake, London—Communicated by W. T. Jebb, United States. Improvements in or relating to the manufacture of malt liquors. April 21

4957 W. R. Lake, London—Communicated by W. T. Jebb, United States. Improvements in or relating to the treatment of maize in the manufacture of spirits. April 21

4988 H. J. Haddan, London—Communicated by P. Lauth, France. Apparatus for drying malt and other granulous materials. April 22

5032 H. E. Brittin, Swindon. An improved kiln for drying brewers' grains, malt, wheat, barley, oats, and other materials. April 23

5090 J. H. Loder, Utrecht, Netherlands. Improvements in the manufacture of alcoholic beverages. April 24

5385 C. E. Avery, London. Improvement in the method of manufacturing aerated or carbonated waters or beverages. Complete specification. May 1

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5483 M. Blumenthal, London. Improvements relating to the preparation of ferments. May 4

5647 G. Barker, London. Improvements in apparatus for aerating malt and other liquors. May 7

5750 J. T. Gough, London. Improvements in the process of drying malt and grain, and apparatus therefor. May 9

5883 A. Boake and F. G. A. Roberts, London. Improvements in brewing. May 13

6072 A. Swonnell, London. An improvement in the manufacture of brewers' finings, wine finings, and jellies, being a perpendicular sieve. May 18

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4981 F. J. Austin, Clapham. Apparatus for disinfecting purposes, chiefly for cisterns, traps, sewers, etc. April 22

4984 R. H. Radford, Sheffield—Communicated by Professor Dr. F. Petri, Germany. A new method of purifying foul or filthy water flowing off from manufactories, suds, and town sewage by means of precipitating the fæces contained in it, of regaining the ammonia and fatty substances, transmutation of the precipitated substances into manure, and of partly regaining the chemicals required for the process. April 22

5153 J. Hewes, London. Improvements in the treatment of excreta and house sewage, and an improved manufacture of material and apparatus therefor. April 25

5179 A. E. Hubert, London. Making a fumigating and disinfecting composition. April 27

5227 C. Lehofer, London. Improvements in the treatment of human excrements, sewage, and similar matter for the manufacture of manure. April 28

5348 M. Nahnsen, London. An improved method of purifying drainage waters and sewage. April 30

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5472 L. Schroter, London. Improvements in apparatus and proceedings for purifying and filtering of waters. May 4

5663 E. Langen, London. Improved apparatus for treating semi-liquid substances with purifying or other liquids. May 7

6051 F. Maxwell-Lyte, London. Improvements in sewage purification processes and those of other foul waters. May 16

6055 W. B. G. Bennett, London. Improvements in the preparation of precipitants for use in the treatment of sewage and other liquids containing solid matters in suspension and solution, and improvements in the treatment of such liquids. May 16

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6081 H. H. Lake, London—Communicated by B. Fannon and C. P. Winslow, United States. Improvements in explosive projectiles or shells for fire-arms or ordnance. May 18

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NOTICE.

Notice is hereby given that the resolution, embodied in the Report of Council to the Annual General Meeting, 1884, which forbids the publication of communications other than those read before the Society or its Sections, is now rescinded. Communications bearing upon Technical Chemistry can now be sent to the General Secretary, and, if they be approved by the Publication Committee, will be inserted in the Journal.

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F. E. Goodhart, 11, Great George Street, Westminster, S.W., solicitor.
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MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

July.—The Annual General Meeting.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held June 1, 1885.

DR. CHAS. GRAHAM IN THE CHAIR.

THE INFLUENCE OF PHOSPHATES UPON FERMENTING WORTS.

BY ALFRED GORDON SALAMON, A.R.S.M., F.C.S.; AND W. DE VERE MATHEW, F.I.C.

THE various considerations which might suggest themselves as affording scope for argument in connection with the research, which we have the honour of submitting to you to-night, are necessarily of a most complex and intricate character; because of the veil of mystery which still envelopes so many of the phenomena, collectively constituting the process of fermentation. Hence it is that we feel the necessity of at once disposing of the possible charge of having aimed at too much, and of stating emphatically that our object has been to solve a problem savouring rather of industrial than of purely philosophic interest; to offer a few contributions which may possibly be capable of direct assimilation to the work of the practical brewer, rather than discuss the abstruse biological and physiological aspects of a subject, of which the sum total of our information must still be said to be represented more by its high-flown nomenclature, than by the extent of knowledge which such nomenclature might be assumed to imply.

If we examine the analysis of the ash of the yeast plant, we shall find that phosphorus enters very largely into its composition. The exact condition in which it exists is probably unknown; but inasmuch as potash is present in notable quantities, and cannot be satisfactorily accounted for in combination, unless by reference to the contained phosphorus, it is assumed, and probably correctly, that the phosphorus of yeast is chiefly combined with mineral bases; and, indeed, that it exists almost entirely as phosphate of potash.

Inasmuch as there is no record of a sample of yeast ever having been isolated of which the ash could not be proved to contain phosphorus; and since experience has proved that no satisfactory growth of the plant takes place in a medium devoid of a certain quantity of this element, it is further assumed—and again we must agree with the deduction—that it constitutes a nutritive element, which is absolutely necessary to a favourable growth and development of the yeast.

If the assumption had been carried no further than this, we should have had no occasion to trouble you with our observations to-night; for we should scarcely have ventured to attack the very difficult, but exceedingly interesting, problem of determining what *rôle* it is that phosphorus actually plays in the nutrition of the plant. But matters have not been allowed to rest here; and it has been urged—apparently with the idea that one cannot have too much of a good thing—that it is advisable to introduce additional phosphate into the medium in which fermentation takes place. We find, for instance, that bone ash is often added, in certain of the wine districts of France, with a view to accelerate the action of the ferment; and, further, that several of the authorities, to whom the brewers look for scientific instruction, advocate the addition of certain phosphates to fermenting worts, in order to increase the efficiency of the action of the yeast. Of late this practice has become so pronounced that there are now several so-called yeast-foods in the market, the active principle in all of them consisting of some form of phosphate.

Now, so far as our reading carries us, we can find no record of any systematic series of experiments having been undertaken, with a view to determine whether any benefit really results from such an addition; and in its absence we are led to the conclusion that the practice is one which is absolutely empirical. In saying benefit we must be understood to limit the expression *to the ultimate product of the manufacturer;* for it would be obviously difficult, if not impossible, to separate the newly-formed cells from the old in such a manner as to determine whether the young cells assimilated more phosphorus than the parent cells. Such a consideration would constitute a type of what we have termed the biological, or physiological, aspects of the question. But it does seem possible to investigate the matter so as to arrive at results which shall have some distinct practical value, and which shall decide whether the use of such "foods" is objectionable or commendable.

In view of the great importance which the subject of yeast nutrition and development possesses for the brewer, we have been induced to undertake the experiments which we now submit, in order to assist him in forming some reliable opinion upon the matter. The vast scope of the subject has, however, compelled us to limit our experiments to brewing operations, and we would state that although they may have some bearing, they have no *direct* reference to the work of the distiller, or the producer of wine.

Granting that the presence of a certain amount of phosphorus, in some combined form, is necessary to the due activity of yeast, it becomes important to inquire to what extent this element is present when brewing operations are conducted under *normal* conditions; how much is assimilated during the process of fermentation; and, further, whether any remains unused in the finished beer.

If it can be shown that finished beer contains a notable amount of phosphorus, originally derived from the malt, and subsequently passing into the wort; that some of the phosphorus of this wort has been absorbed or assimilated during fermentation, and that a considerable proportion has been left untouched; then—inasmuch as the finished beer has no opportunity of obtaining any phosphorus which it did not contain in the wort—unless it can be proved

that the phosphorus, which is left, has undergone some modification of combination, which has rendered it inert for purposes of yeast assimilation ; or that it originally existed in an unavailable condition, it would certainly appear, *primâ facie*, that there can be no object in adding a further supply.

The following tables of analyses which we have performed, are instructive upon this point :—

ANALYSIS OF SAMPLES OF 1884 MALT.

No.	Locality.	On Dry Substance. Ash	Total N.	Soluble N	P_2O_5.
		Per cent	Per cent.	Per cent	Per cent.
1.	{ Austria	2·51	1·460	·956	1·101
1.	{ Moravia	2·47	1·371	·932	·635
3.	Hertfordshire	2·29	1·385	1·103	·917
4.	Suffolk	2·19	1·346	·789	·919
5.	Nottinghamshire..	2·26	1·277	1·189	·889
6.	Co. Kildare	2·34	1·628	·824	1·082
7.	Sweden	2·47	1·665	·910	·995
8.	Suffolk	2·19	1·598	1·193	·880
9.	Suffolk	2·09	1·610	·877	·825
10.	Suffolk	2·21	1·700	·759	·913
11.	Fifeshire	2·81	1·421	·845	1·104
12.	Suffolk	2·09	1·686	·911	·858
13.	Wexford	2·31	1·551	·746	·718
14.	Essex	2·33	1·354	·905	·913
15.	Kings Co.	3·30	1·452	·662	1·023
[16.]	Smyrna	3·11	1·598	·844	·732

TABLE SHOWING AMOUNT OF P_2O_5 IN VARIOUS WORTS.

(P_2O_5 in grammes per 100 cc.).

1.	·179	grammes (pure malt wort).
2.	·197	,, containing brewing sugar.
3.	·111	,, ,, ,,
4.	·086	,, ,, ,,
5.	·088	,, ,, ,,
6.	·130	,, ,, ,,
7.	·075	,, ,, ,,
8.	·118	,, ,, ,,

TABLE SHOWING AMOUNT OF P_2O_5 REMOVED FROM WORT DURING FERMENTATION.

(P_2O_5 in grammes per 100cc.).

	Wort.	Beer.	P_2O_5 removed.
1.	·193	·143	·050
2.	·122	·094	·028
3.	·067	·051	·016
4.	·180	·159	·021
5.	·166	·138	·028
6.	·127	·100	·027
7.	·107	·082	·025
8.	·074	·057	·017

The phosphoric acid estimations contained in the above tables, as indeed all similar analyses to which we shall have occasion to refer in the course of this paper, were made gravimetrically upon the ash yielded by a given quantity of the liquid, or the malt. The phosphate was precipitated with ammonic molybdate solution, and allowed to stand in a warm place all night, and then filtered off. The precipitate was next dissolved on the filter with ammonia and reprecipitated with magnesia mixture. After allowing to stand in the cold for at least twelve hours, the resulting ammonic magnesic phosphate was filtered, thoroughly washed, strongly ignited, and the resulting magnesic pyrophosphate weighed.

An inspection of the table showing the amount of P_2O_5 removed during fermentation, proves that the quantity required for yeast nutrition, or whatever function it may perform, is exceedingly small. We have never met with a case in which, during what we may term the commercial limits of attenuation, the quantity thus removed has exceeded ·05 gramme per 100cc. of wort fermented.

Again, the table clearly shows that in every case, at the conclusion of the fermentation there exists a quantity of unabsorbed, or unremoved, phosphorus. As we have stated, this *may* exist in some form of combination different to that which *has* been removed ; and consequently it may be present in an absolutely inert condition ; but we are ourselves unaware of any reliable arguments, which could be adduced to support such a contention.

The practice, now almost universal in English brewhouses, of employing a certain quantity of some ready-made brewing sugar in the process of manufacture, will undoubtedly have the effect of reducing the amount of phosphorus present in the wort. Advantage has been taken of this fact to urge the desirability of adding yeast-foods to supply this deficiency. In order to test the value of this assertion, we have estimated the amount of phosphorus (as P_2O_5) in worts containing brewing sugar, and obtained from various parts of the country ; and it will be seen that in every analysis we have made, we have found considerably more phosphoric anhydride present in the wort than we have found to be removed during the normal period of fermentation.

Hence it would certainly appear that English beer worts do contain much more phosphorus than is required for fermentative purposes.

The analyses of the malts have disclosed certain facts, so distinctly at variance with the doctrines promulgated by some of our leading authorities ; that at the risk of a somewhat serious digression from the true scope of our paper, we feel compelled to direct attention to them.

In a paper upon lager beer read before this Society by Dr. Graham, the following statement occurs :— Speaking of the analyses of lager beer, he says : "In these analyses the nitrogen has been determined by the soda lime process which is employed by most German analysts, by whom the factor 6·25 is used to convert the nitrogen into albumenoids. This is misleading, and gives results far too high, since all nitrogenous compounds are thus calculated as albumenoids. For many years past I have used boiling alkaline permanganate as a more correct method of arriving at the albumenoids, and in the analyses of the English ales and German beers made by me, the albumenoids so found were given. Though the process is far from being scientifically accurate, yet the method, from a technical point of view, has been of great service to me in forming an opinion as to the relative merits of *malt* from an English brewing point of view ; and of equal service in deciding as to the keeping qualities of store ales. Thus with English ales I have, for some years past, adopted the factor ·01 of albumenoids, as given by the moist combustion process, as the standard for sound English ales per 1lb. per barrel original gravity ;" and again further on he states that "we find English brewers competing with each other for the finest barleys, *that is, for those with least yield of soluble albumenoids.*" (The italicised portions of these quotations are underlined by us.)

Now those who have had any experience with the moist combustion process, as applied to the determination of nitrogen in malts and worts, will cordially agree with Professor Graham, when he speaks of its scientific inaccuracy ; and, unless it be upon the

score of convenience, we cannot see that it is to be preferred to the old-fashioned soda lime process. Undoubtedly, it may afford comparative results, and would seem to have induced Dr. Graham to form the opinion—which is the only one to be inferred from the above quoted passages—that for the purposes of the English brewer the best malts are those which yield the least amount of soluble albumenoids; and inasmuch as he has fixed a standard of soluble albumenoids for ales, above which he would not pass them for store purposes, we feel further justified in concluding that he would condemn, as unfit for use by the English brewer, a malt giving a high yield of soluble albumenoids.

Now this decision, coming from so great an authority, is of such importance to English brewers and maltsters, that we would ask your indulgence while we examine into its accuracy.

The nitrogen determinations, as represented upon our table of malts, were made in the following manner:—

For the total nitrogen, about ·2grm. of the finely-ground malt were washed into a combustion tube with copper oxide, and the usual roll of copper was inserted in the tube. The unsealed end of the tube was then drawn out, and connected with a Sprengel pump; the furnace being lighted at the end farthest from the malt, the pump was started and a vacuum obtained; and the combustion was then effected in vacuo. Over the mouth of the delivery tube of the pump was placed a tube containing mercury, and also some strong caustic potash, to absorb the carbonic anhydride, evolved as a product of the combustion of the malt. The resulting nitrogen gas, collected over mercury and caustic potash, was next transferred to a gas apparatus, and, after all necessary corrections had been made, the volume of nitrogen thus measured was converted into its corresponding weight in grammes.

For the soluble nitrogen, a mashing of the malt upon the small scale was made; but inasmuch as we preferred to work with small quantities of material, we did not dilute the extract until it obtained the quantity of soluble nitrogen, that would be represented by an English wort. Such a dilution was quite unnecessary for our purposes. In each case, the method of procedure was absolutely the same, *so that the results are rigidly comparable.* We proceeded as follows:—A grist corresponding to that in use in breweries was made of each sample of malt; 25grm. of malt were weighed into a beaker, into which 125cc. of distilled water were introduced, at such a temperature that the initial heat was about 50° C. This was maintained for about twenty minutes. The temperature was then raised to about 60° C., and thus maintained until the iodine reaction showed that a complete conversion had been effected. The temperature was then raised to about 70 C., and then the water in the bath was made to boil for about five minutes. The extract was next filtered off hot, and washed out in each case to the same extent. It was cooled, and then 1cc., after well stirring, was evaporated gently, and the residue submitted to combustion in vacuo, as before.

The resulting soluble nitrogens, thus obtained, were not multiplied by us by the factor 6·25; because, with all deference, we regard the use of such a factor as simply effecting an increase in the possible error of experiment; and, at the same time, as expressing the ignorance, which we share in common with other chemists, as to the true mode of combination of nitrogen, and more especially of soluble nitrogen, in malts and worts.

Dr. Graham maintains that the total soluble nitrogen estimations, as indicated by the soda-lime process, are far too high, since all nitrogenous compounds are thus calculated as albumenoids; but we take it that Dr. Graham would scarcely contend that the nitrogen results, as yielded by the moist combustion process, give a reliable indication of the *manner* in which the nitrogen is combined—that they show any distinction between the amides and proteins and peptones. Dr. Graham's results being lower than those obtained by the soda-lime process, it would be interesting to know in what manner he accounts for the remaining nitrogen, which is undoubtedly present. In what form does it exist? It is certainly in a soluble condition; and what reasons are there for regarding it other than as soluble albumenoid matter? If there are any reasons, are they sufficient with which to build up a standard which shall condemn or pass malts for brewing purposes? In the absence of further information we are inclined to think they are quite insufficient; and we can further state that results which we have seen obtained by this moist combustion process are simply mystifying.

We have felt it necessary to take these preliminary objections, because the results which we have obtained show that on no account should a malt be condemned for English brewing purposes because it contains a high amount of soluble nitrogenous matter.

In order to give our results some practical value, we decided to obtain the opinion of experts upon the physical appearances of the malts upon which we experimented, and to see how their verdict would correspond with our analyses. Among others we submitted them to Mr. Frank Wilson, the head brewer to Messrs. Combe & Co., who kindly undertook to classify them for us. The sixteen malts (supplied from the bins of different breweries) were laid out upon a table, and the laboratory number was placed upon each sample. The malts were not placed in what we considered their order of merit, but indiscriminately, and Mr. Wilson had no information, other than his experience to guide him. The numbers upon the Table of Malt Analyses represent the exact order in which he placed them. The sample of Smyrna malt being so different from the others could be at once detected, and was, therefore, placed out of the competition. Now, looking at the amounts of soluble nitrogen in the fifteen remaining malts, and further, having reference to the order in which they were placed, it will at once be seen that the best malts are among those containing the highest percentages of soluble nitrogen, and that the worst of all (No. 15) contains the least. This last was declared by Mr. Wilson *to be very deficient in germinating power.*

We do not go so far as to reverse Professor Graham's statement, and declare that the more soluble nitrogen a malt yields the better it is for brewing purposes; but we do think that such an assertion would be nearer the truth than the converse.

A practical result, arising from Mr. Wilson's verdict upon the malts, is that a malt, which appears to have been well nourished upon cultivated land is, other things being equal, richer in soluble nitrogen than a poorly grown malt, and this is probably the reason why the malts are placed as they are in the table.

The amount of nitrogen in malts and worts is undoubtedly of the very greatest moment; but we submit that very little is to be gleaned from its estimation until we are in a position to determine the mode of combination in which it is actually present.

We should add that other gentlemen who were good enough to examine the malts, placed them almost exactly in the same order as did Mr. Wilson.

[Mr. Salamon here asked the Chairman's permission to inform the meeting that he had that day seen Mr. Wilson, and had read the paper to him. Mr. Wilson had authorised him (Mr. Salamon) to express to the meeting his regret at being prevented by indisposition from attending; and further, to state that he entirely agreed with the interpretations which had been placed upon his classification of the malts as given in the table.]

It has been repeatedly stated that the standard of a good malt, when considered with reference to its fitness for use in the decoction process, does not necessarily constitute a standard for judging of the suitability of a malt for use by the method of infusion. This arises from the fact that beer produced by the decoction process contains more nitrogenous matter in solution than does the beer prepared by the process of infusion. If this statement be rigidly correct, it detracts to a certain extent, in the eyes of the English brewer, from the value of the researches, which have been conducted by foreign observers upon this question; but it can scarcely interfere with the importance attaching to the results which they have published respecting yeast nutrition.

So far as the nitrogen in malts and worts is concerned, we find that they substantially agree with our own observations. Let us briefly glance at some of them.

K. Reischauer (*Bied. Centr.* 1882, 12) finds that malting barleys differ very materially in their composition. He summarises his results as follows:—

	Nitrogen.	Ash.	P_2O_5.
Maximum ...	2·856· ...	3·340· ...	1·145
Minimum ...	1·282· ...	2·120· ...	·614
Mean	1·729· ...	2·799· ...	·902

Dr. C. Lintner, an authority of great repute, goes so far as to state (*Dingl. Polyt. J.* 251, 225-228) that the amount of nitrogen in barley or malt bears no relation to its diastatic action and he also expresses it as his opinion (*Dingl. Polyt. J.* 247, 350) that barley should contain at least 1·67 per cent. of nitrogen in order to produce a good beverage.

Thausing, whose book upon brewing is so highly esteemed in this country, makes a statement (*Dingl. Polyt. J.* 247, 350) which will surprise not a few of you here to-night, to the effect that a wort will not form a good nutrient for yeast unless it contains a comparatively large amount of soluble nitrogenous matter. It is only within recent years, he says, that this fact has received the attention which it deserves; and it is now recognised that barley containing little proteid matter gives malt, the starch of which is with difficulty convertible into sugar.

It is interesting to compare this statement with Mr. Wilson's opinion upon No. 15 malt as analysed by us.

Heinzelmann (*Bied. Centr.* 1880, 475-478) finds that the yeast-producing power of grain is not proportionate to the quantity of nitrogen it contains, but to the amount of soluble protein. This he states to be a very variable quantity.

Some chemists consider the presence of soluble nitrogen of such importance in promoting germination, that they go so far as to recommend its addition to the steep-water used in the production of malt. Thus, Mills and Pettigrew (*Chem. Soc. J.* 1882) advise the use of small quantities of calcic nitrate for this purpose, and they are confirmed in their view by Michel and Jaeckel-Handwerk (*Dingl. Polyt. J.* 247, 82-85, 168-173, 214-218), who state that the reputation of the Burton steep-water is attributable to the fact that it contains nitrates, which promote germination.

[We have not had an opportunity of repeating these last interesting experiments, and therefore we merely quote them.]

A question which has not yet received its due share of attention, but which is undoubtedly of the greatest importance, arises out of the influence of kiln-heat upon the nitrogenous constituents of malt. It is found that the amount of nitrogen diminishes with the increase of heating, but (*Bied. Centr.* 1881, 357) that the change in the amount of nitrogen produced by malting at a high temperature, does not correspond with a change in the diastatic action of the malt. Hence it is necessary to examine malt, with respect to its firing, before forming any opinion as to the amount of nitrogen present in it.

We have again to request that the importance of the subject into which we have digressed may be considered as a sufficient excuse for our having committed the offence.

In making the estimations of soluble nitrogen in the malts, we were under the impression that we might possibly discover the existence of some relation between the quantity of nitrogen and of phosphorus. In this view we were mistaken; no such relation exists; and we have since found that we are confirmed in this opinion by L. Marx (*Bied. Centr.* 1884, 853-855), who made no less than 400 analyses of different malts with an exactly similar object. All that we can say is, that the amount of phosphorus in malts varies within very wide limits; and that when the barley is grown on a highly cultivated land, the amounts of phosphorus and of nitrogen will both be high; and that when the land is poor, as in the case with Smyrna malt, the amount of phosphorus will be low. When the phosphorus is low, the yield of barley will probably not weigh so much per acre; but for brewing purposes, as regards the quality of beer obtainable, the malt produced from it may be equally good. Thus, the first two malts upon the list are both classed as No. 1 for brewing purposes, because they are equally good as judged by external appearances; but Mr. Wilson is of opinion that the yield per acre of Austrian malt would have been much greater than of Moravian; and we find that the former is much higher in phosphorus and soluble nitrogen than the latter. Again, Smyrna malt, which is exceedingly useful in some cases, would not yield a large crop by weight; and we find that it is low in its percentage of phosphorus.

But although good malts in many cases yield a high percentage of phosphorus, it by no means follows that an excess of it exerts a favourable action either upon the character of the wort or the subsequent fermentation. Indeed, we have every reason to believe that the contrary is the case.

It is known that certain of the soluble nitrogenous bodies, germane to worts, are exceedingly rich in phosphates. This is especially the case with the unreal peptones, which are said to contain the phosphorus in the form of a compound ether. One of these unreal peptones—viz., glutin-casein—frequently exists in considerable quantities in worts. It is decomposed on boiling, so that when the wort "breaks" the phosphorus passes into solution in the form of acid phosphates; and Thausing states that they are in a great measure responsible for the acidity of worts, and ascribes to such decomposition of certain nitrogenous combinations the fact, which he has noted, that the longer a wort is boiled the more acid it becomes.

If this be so, it can scarcely be urged that the presence of phosphates constitutes an unmixed bless-

ing. W. Detmar (*Bied. Centr.* 1883, 71) is still more emphatic in his view, for he states that phosphoric acid, if present in worts in large quantities, completely destroys the action of the diastase.

So much, then, for the phosphates in malt and worts. Let us now proceed to ascertain the influence which they exercise upon the subsequent fermentation.

The preliminary experiments which we conducted upon this subject, were performed upon materials over which, we considered, we could exercise absolute control. We were anxious to eliminate every possible source of error, arising from the varying composition of commercial worts; and we therefore employed artificial nutritive media similar to that of which "Pasteur's solution" is a type. We added varying quantities of different phosphates to equal quantities of the same solution, fermented with the same amount of yeast in each case; and noted the variation which had been exercised upon the separate fermentation of each series, by estimating the amount of cane sugar which had been decomposed in a given time. This, of course, corresponds to the production of comparable quantities of alcohol during the same period; for we thought that we might disregard the energy involved in the inversion of the cane sugar by the yeast prior to fermentation, because the error, if any, was constant throughout. The sugar was, in each case, estimated gravimetrically by Fehling's solution. The solutions were thoroughly sterilised, and subsequently cooled, before the addition of the yeast. The vessels containing the varying quantities of phosphates in the artificial solutions were all kept under exactly similar conditions of temperature. The temperature of pitching was in all cases 60° F.

The amount of yeast added corresponded to 1¼lb. avoirdupois per barrel, which may be taken as the average quantity used upon the commercial scale.

The ingredients used in the preparation of the solutions were chemically pure.

Appended are some of the typical results actually obtained, together with details as to the varying quantities of solution and yeast employed, and as to the time during which fermentation was allowed to proceed:—

POTASSIUM PHOSPHATE.

Potassium Phosphate in solution, in grammes per 100cc.	Equal to P_2O_5, in grammes per 100cc.	1st Series. Sugar used, grammes per 100cc.	2nd Series. Sugar used, grammes per 100cc.	4th Series. Sugar used, grammes per 100cc.
0·0000	0·0000	9·4604	8·5770	5·6352
0·0575	0·0192	9·4920	8·5896	6·5054
0·1150	0·0385	9·8740	8·5001	6·9448
1·1720	0·0577	—	8·7666	—
0·2300*	0·0770	10·1070	9·6884	6·9228
0·2875	0·0962	9·1934	9·9124	—
0·3450	0·1155	8·6677	7·7586	6·3160
0·4025	0·1348	8·5644	7·5948	6·2002
0·4600	0·1541	8·0474	7·8878	5·2820
0·5175	0·1733	8·3662	7·2850	4·6089
*Quantity normal to Pasteur's solution.		100cc. solution. ·5grm. yeast. Time, 18hrs.	100cc. solution. ·5grm. yeast. Time, 18hrs.	300cc. solution. 1·01grm. yst. Time, 60hrs.

CALCIUM PHOSPHATE.

Phosphate of Calcium, in grammes per 100cc.	Equal to P_2O_5, in grammes per 100cc.	Sugar used, in grammes per 100cc.
0·0000	0·0000	7·8746
0·00575	0·0026	7·8314
0·01150	0·0052	7·8213
0·01725	0·0079	7·8056
0·0230*	0·0105	7·6936
0·02875	0·0131	7·6936
0·03450	0·0177	7·6504
0·04025	0·0184	7·2456
0·04602	0·0211	—
0·05175	0·0237	7·9604
0·2070	0·0948	6·7114
	*Normal.	3rd Series. 300cc. solution, 1·01grm. of yeast. Time, 60 hours.

In this experiment the normal amount of potassium phosphate was present in addition to the calcium phosphate.

MAGNESIUM PHOSPHATE.

Phosphate of Magnesium, in grammes per 100cc.	Equal to P_2O_5, in grammes per 100cc.	Sugar used, in grammes per 100cc.
0·0000	0·000	4·9972
0·0575	0·003	4·7558
0·01150	0·006	4·1410
0·01725	0·009	4·4281
0·0230	0·012	4·2562
0·02875	0·015	4·1852
0·03450	0·018	4·3078
0·04025	0·021	3·9200
0·04602	0·024	4·6376
0·05175	0·027	4·2562
		300cc. solution, 1·01grm. of yeast. Time, 60 hours.

In this experiment the amounts of potassium and calcium phosphates, normal to Pasteur's solution, were employed in addition to the magnesium phosphate.

Now, whatever may be the value attaching to these preliminary experiments, from the practical brewers' standpoint, it will not be denied that they possess a certain value; for they show, clearly enough, that the presence of a certain amount of potassium and calcium phosphates is advantageous in promoting the decomposition of cane sugar by yeast in a given time; and that beyond a certain limit, which very nearly approaches the normal amount of such bodies prescribed by Pasteur for addition to his solution, a decided decrease takes place in the amount of cane sugar so decomposed. They further show that the addition of magnesium phosphate to such solutions is of no use; inasmuch as it would appear to be practically inert as regards the decomposition of cane sugar in a given time.

We have next to decide whether a similar result attends the introduction of such phosphates, and of other forms of phosphates, into worts prepared in the brewhouse for conversion into beer.

In order to arrive at a satisfactory conclusion in the matter we have proceeded as follows :—

In all cases commercial worts were employed—*i.e.*, worts obtained from breweries, and prepared for fermentation with a view to the production of beer. Much larger quantities were operated upon than in the preliminary experiments, no less than 1000cc. being used in each case. The yeast was also what may be termed commercial yeast—*i.e.*, it was fresh yeast, actually used in brewing operations. It was always freed from associated liquid by pressure prior to pitching, but the pressure was never allowed to be sufficient to injure the cells. In every case a microscopic examination of the yeast and measurement of the cells were made prior to use. If any cells were burst the samples were rejected, and a similar treatment followed the discovery of any dead or weak cells, as disclosed by staining with soluble aniline blue.

The wort was always examined microscopically prior to use, and if impure was rejected ; if pure, it was heated to 75° C. for some time, and then cooled down to 15° C. It should be added that the wort was always obtained by us after it had been passed through the refrigerator, so that it had been both boiled and hopped.

After the wort had been cooled, it was thoroughly mixed, a portion retained for immediate analysis, and three separate quantities of 1000cc. each introduced into large open-mouthed glass vessels (resembling fermenting tuns in shape), kept as nearly as could be under identical conditions of temperature, and certainly under conditions favourable to fermentation. The vessels were numbered. To the first *no* combination of phosphorus was added ; to the second was added sufficient of the combination to produce the equivalent of P_2O_5 of soluble phosphate in normal Pasteur's solution ; and to the third was added double that amount.

With each 1000cc. of wort, 3·5grm. of yeast (equal to 1½lb. avoirdupois per barrel) were then mixed, and fermentation was allowed to proceed during forty-eight hours. We found this time best suited to the manipulation of such comparatively small quantities of wort; although we did not find any variation in the ultimate results by allowing a longer period of time for fermentation.

The three vessels being under identical conditions, containing equal amounts of wort, equal amounts of yeast, and only varying in the amounts of phosphorus which they contained (which amounts we had under our own immediate control), we were in a position to note the comparative effects produced by increasing quantities of the phosphorus combination.

At the conclusion of the fermentation a measured quantity of beer from each vessel was passed through a fine filter, after well stirring up the beer and yeast in the vessel; and the yeast, so obtained, was calculated after making due corrections for moisture. The results thus obtained as to yeast quantity were necessarily very inaccurate ; but they furnished us with *comparative* results of great value.

The remainder of the beer from each vessel was filtered, and a measured quantity retained for analysis.

The yeast, after fermentation, was examined under the microscope, and the *comparative* size of the cells noted.

We considered it necessary, for the purposes of this research, to obtain answers to the following questions :—

(1.) Does the addition of any combination of phosphorus to a beer-wort cause any more phosphorus to be removed from the wort during fermentation, than would be removed if no such phosphorus were added ?

(2.) Does the addition of phosphorus, in combination, to a wort cause a greater amount of soluble nitrogenous matter to be removed, or assimilated, during fermentation, than if no combination of phosphorus were added ?

(3.) Does the addition of phosphorus, in combination, to a wort cause the production of a greater amount of alcohol in a given time, than would be the case if no such phosphorus were added ? In other words, does it produce a more rapid attenuation of the wort ?

(4.) Does the addition of phosphorus, in combination, to a wort effect an increase in the amount of yeast produced in a given time ?

(5.) Is the yeast so produced better adapted for pitching purposes than if no such phosphorus were added ? In other words, is it more vigorous and has it assimilated any of the elements necessary to its growth in greater quantity than would otherwise have been the case ?

Unless some, or all, of these questions could be answered in the affirmative, we hold we are justified in concluding that, for the purposes of the brewer, the addition of phosphates to fermenting worts is unjustifiable.

We attempted to obtain answers to these questions in the following manner :—

The wort, before being fermented, was examined :—

1. For gravity.
2. For nitrogen.
3. For phosphorus (as P_2O_5).
4. The amount of yeast added was noted, and the size of the cells measured.

The resulting beers were examined for :—

1. Alcohol per cent. by weight.
2. Nitrogen.
3. Phosphorus (as P_2O_5).
4. Weight of yeast produced, and size and condition of growth of resulting cells.

Unless a greater quantity of yeast resulted from the addition of phosphorus, the first question, as to the amount of phosphorus assimilated by the yeast, would certainly be answered by estimating the P_2O_5 in the wort, and comparing the amounts contained in the three beers produced from it. If, on the other hand, more yeast were produced, more phosphorus would be required, and the result would point in favour of the use of phosphates.

The estimation of nitrogen is of the greatest value, because it settles the question of yeast production. M. Delbrück and others (*Bied. Centr.* 1880, 217-222) have found as the result of a very beautiful investigation, that the chemical composition of a definite sample of pitching yeast remains absolutely constant during its development in the wort ; and that the new yeast produced is identical in chemical composition with the old, so that the amount of nitrogen removed from a wort during fermentation, becomes an exact measure of the amount of yeast produced during that period. They find this process exceedingly accurate, and further add that the formation of the yeast-cells has practically no connection with the visible working of the wort.

We may state at once that in no case did we find any alteration in the size and condition of the yeast-cells, upon the addition of phosphorus combinations, unless we added a great excess, when we found the cells to be stunted in growth and shrivelled.

Ortho-Phosphoric Acid.

	Wort. 1.	2.	3.		Beer. 1.	2.	3.
Sp. gr.	1·0578	1·0587	1·0595	Alcohol per cent. by weight	4·57	4·20	4·02
P_2O_5 per 100cc.	·145	·209	·281	P_2O_5 per 100cc.	·107	·172	·249
N. ,, ,,	·111	·116	·114	N. ,, ,,	·076	·092	·093
Weight of dry yeast taken	1·04	1·04	1·04	Wgt. of dry yeast produced	5·473	5·330	5·976

		Grm.		Grm.
No. 1 had no phosphoric acid added.	No. 1. P_2O_5 removed...	·038	No. 1. N. removed	·035
,, 2 had 1·06grm. phosphoric acid added.	,, 2. ,, ,, ...	·037	,, 2. ,, ,, ...	·024
,, 3 had 2·12grm. phosphoric acid added.	,, 3. ,, ,, ...	·032	,, 3. ,, ,, ...	.021

Meta-Phosphoric Acid.

	Wort. 1.	2.	3.		Beer. 1.	2.	2.
Sp. gr.	1·028	1·029	1·029	Alcohol per cent. by weight	1·83	1·89	1·73
P_2O_5 per 100cc.	·079	·127	·182	P_2O_5 per 100cc.	·051	·115	·167
N. ,, ,,	·054	·069	·064	N. ,, ,,	·030	·033	·055
Weight of dry yeast taken	1·03	1·03	1·03	Wgt. of dry yeast produced	2·118	1·817	1·574

	Grm.		Grm.		Grm.
No. 1. Meta-phosphoric acid	0·00	No. 1. P_2O_5 removed...	·028	No. 1. N. removed......	·024
,, 2. ,, ,, ...	·87	,, 2. ,, ,, ...	·012	,, 2. ,, ,, ...	·036
,, 3. ,, ,, ...	1·74	,, 3. ,, ,, ...	·015	,, 3. ,, ,, ...	·009

Potassium Phosphate.

	Wort. 1.	2.	3.		Beer. 1.	2.	3.
Sp. gr.	1·0481	1·0500	1·0510	Alcohol per cent. by weight	3·78	3·73	4·02
P_2O_5 per 100cc.	·127	·291	·346	P_2O_5 per 100cc.	·100	·277	·344
N. ,, ,,	·121	·125	·131	N. ,, ,,	·050	·058	·056
Dry yeast added	1·1145	1·1145	1·1145	Dry yeast produced	6·659	6·893	6·858

	Grm.		Grm.		Grm.
No. 1. Potassium phosphate............	0·0	No. 1. P_2O_5 removed...	·027	No. 1. N. removed......	·071
,, 2. ,, ,, ...	2·33	,, 2. ,, ,, ...	·014	,, 2. ,, ,, ...	·067
,, 3. ,, ,, ...	4·66	,, 3. ,, ,, ...	·002	,, 3. ,, ,, ...	·075

Magnesium Phosphate.

	Wort. 1.	2.	3.		Beer. 1.	2.	3.
Sp. gr.	1·0892	—	—	Alcohol per cent. by weight	4·82	5·32	5·20
P_2O_5 per 100cc.	·180	—	—	P_2O_5 per 100cc.	·159	—	—
N. ,, ,,	·266	·269	·260	N. ,, ,,	·166	·175	·174
Dry yeast added	—	—	—	Dry yeast obtained	—	—	—

	Grm.			Grm.
No. 1. Magnesium phosphate	0·00	No. 1.	No. 1. N. removed......	·100
,, 2. ,, ,, ...	2·07	,, 2.	,, 2. ,, ,, ...	·094
,, 3. ,, ,, ...	4·14	,, 3.	,, 3. ,, ,, ...	·086

Magnesium Phosphate Dissolved in Sulphurous Acid.

	Wort. 1.	2.	3.		Beer. 1.	2.	3.
Sp. gr	1·044	1·046	1·049	Alcohol per cent. by weight	3·37	3·20	—
P_2O_5 per 100cc.	·107	·172	·250	P_2O_5 per 100cc.	·082	·156	·271
N. ,, ,,	·091	·109	·096	N. ,, ,,	·056	·067	–
Dry yeast added	1·16	1·16	1·16	Dry yeast obtained	6·252	5·355	1·991

	Grm.		Grm.		Grm.
No. 1. Magnesium phosphate	0·00	No. 1. P_2O_5 removed	·025	No. 1. N. removed	·035
,, 2. ,, ,, ...	2·07	,, 2. ,, ,, ...	·016	,, 2. ,, ,, ...	·042
,, 3. ,, ,, ...	4·14	,, 3. ,, ,,	Increase.	,, 3. ,, ,, ...	—

Calcium Phosphate.

	Wort. 1.	Wort. 2.	Wort. 3.		Beer. 1.	Beer. 2.	Beer. 3.
Sp. gr.	1·0839	—	—	Alcohol per cent. by weight	3·43	4·14	4·02
P_2O_5 per 100cc.	·193	—	—	P_2O_5 per 100cc.	·153	—	—
N. ,, ,,	·020	—	—	N. ,, ,,	·015	·016	·015
Dry yeast used	1·2102	—	—	Dry yeast produced	5·043	—	—

	Grm.		Grm.
No. 1. Calcium phosphate added	0·00	No. 1. P_2O_5 removed	·04
,, 2. ,, ,, ,,	1·68	N. removed	No increase.
,, 3. ,, ,, ,,	3·36		

Ammonium Phosphate.

	Wort. 1.	Wort. 2.	Wort. 3.		Beer. 1.	Beer. 2.	Beer. 3.
Sp. gr.	1·0451	1·0459	1·0169	Alcohol per cent. by weight	3·43	3·37	3·49
P_2O_5 per 100cc.	·079	·171	·265	P_2O_5 per 100cc.	·071	·139	·245
N. ,, ,,	·104	·130	·150	N. ,, ,,	·061	·082	·118
Dry yeast added	1·0260	1·0260	1·0260	Dry yeast obtained	5·527	6·352	6·568

	Grm.		Grm.		Grm.
No 1. Ammonium phosphate added	0·00	No. 1. P_2O_5 removed	·008	No. 1. N. Removed	·043
,, 2. ,, ,, ,,	1·6	,, 2. ,, ,,	·032	,, 2. ,, ,,	·048
,, 3. ,, ,, ,,	3·2	,, 3. ,, ,,	·020	,, 3. ,, ,,	·038

Ammonium-magnesium Phosphate.

	Wort. 1.	Wort. 2.	Wort. 3.		Beer. 1.	Beer. 2.	Beer. 3
Sp. gr.	1·0479	1·0480	1·0482	Alcohol per cent. by weight	3·73	3·78	3·37
P_2O_5 per 100cc.	·077	·117	·115	P_2O_5 per 100cc.	·059	·127	·204
N. ,, ,,	·109	·112	·121	N. ,, ,,	·067	·074	·087
Dry yeast added	1·05	1·05	1·05	Dry yeast obtained		—	—

	Grm.		Grm.		Grm.
No. 1. Ammonium-magnesium phosphate added	0·00	No. 1. P_2O_5 removed	·018	No. 1. N. removed	·042
,, 2. ,, ,, ,,	1·60	,, 2. ,, ,,	An increase.	,, 2. ,, ,,	·038
,, 3. ,, ,, ,,	3·20	,, 3. ,, ,,	An increase.	,, 3. ,, ,,	·034

The combinations of phosphorus with which we worked were the following:—

1. Ortho-phosphoric acid.
2. Meta-phosphoric acid.
3. Potassium phosphate.
4. Magnesium phosphate (*a*) in powder.
   (*b*) dissolved in sulphurous acid.
5. Calcium phosphate.
6. Ammonium Phosphate.
7. Ammonium-magnesium phosphate.

The most reliable, and the most typical, results obtained by us are shown in the tables on this and previous page.

There can scarcely be two opinions as to the interpretations which should be placed upon the results, which we have obtained, and so far as the matter has been investigated by other chemists, their observations tend precisely to the same conclusions as our own. Thus:—

M. Hayduck (*Bied. Centr.* 1881, 782) finds that fermentation is retarded by ·4 per cent. to ·5 per cent., and is suppressed by 1·3 per cent. of phosphoric acid.

W. Detmer (*Chem. Centr.* 1882, 461) finds that concentrated phosphoric acid is destructive of ferment life.

A. Mayer (see Thausing, p. 536) states that it is potassium phosphate which furnishes the nutriment to yeast; and that its place cannot be supplied by any other phosphate.

We are now in a position to summarise the results of our experiments as follows:—

1. There is no relation to be found between the phosphorus and nitrogen of a malt, or of a wort prepared from such malt.

2. The amount of phosphorus in a malt, and consequently in a wort, is a very variable quantity. There is no evidence to show that a large amount acts beneficially, either upon the wort itself, or its subsequent fermentation; but there is abundant evidence to show that its effect is decidedly injurious to both.

3. The presence of increasing quantities of phosphoric acid does not increase the growth of yeast, as indicated by the size or appearance of the cells beneath the microscope, or by the amount of nitrogen removed from the wort, which amount has been found to be a rigid measure of the yeast-growth. On the contrary, a decrease in such quantities occurs, and further, no more phosphorus is assimilated by, or removed from, the yeast than would have been the case if no artificial addition of phosphoric acid had been made.

4. The same remarks apply to the effect of increasing quantities of potassium and of calcium phosphates;

also of magnesium phosphate, and of magnesium phosphate dissolved in sulphurous acid.

5. The addition of ammonium phosphate, and of ammonium-magnesium phosphate, causes a slight increase in the amount of P_2O_5 removed, or may be assimilated, during fermentation; but there is no evidence to prove that it exercises any improvement in the yeast-growth. On the contrary, the amount of nitrogen removed does not increase, as it should do, if the yeast-growth underwent any *variation* favourable to the use of such phosphates, and the attenuations do not point to a marked increase of alcohol in a given time.

6. Ammonium phosphate and ammonium-magnesium phosphate are the only two combinations which can be said to effect any improvement at all; and in any case it is so slight as to be almost negligeable.

7. The amount of phosphorus required for assimilation during fermentation is very small, and, as a rule, very much less than the nitrogen weight for weight.

8. The amount of phosphorus present in worts, made from malt alone, and in worts containing added brewing sugars, is always, so far as we can ascertain, in excess of the quantity assimilated by the yeast, during the normal period of fermentation.

When first we announced our preliminary experiments upon this subject it was claimed that they were incomplete; and would not apply to the work of the brewhouse, inasmuch as they were not performed upon materials actually employed in the brewery. We were well aware at the time of the difficulties in the way of making the experiments upon worts; but we have ventured to overcome them, with a view to afford the brewer the information necessary to enable him to form a reliable opinion as to the merits of a question, which exercises much more influence upon his operations than he may hitherto have been prepared to admit.

If we have succeeded in this endeavour, we shall consider ourselves well repaid for the time, and trouble, we have expended upon the experiments.

DISCUSSION.

Dr. Graham said: In calling upon those, who desire to discuss the valuable paper we have had the pleasure of hearing this evening, I take the opportunity of remarking that the very many representatives of the brewing and allied industries present, prove that, at the establishment of the Society of Chemical Industry, we did well to include fermentation processes among the subjects of applied chemistry, which the Society was established to study and promote. Brewing, distilling, and other industries allied to these, are well represented among the members of our already large Society, and as there are many present to-night specially competent to discuss the authors' contribution to the chemistry of fermentation, I have much pleasure in now asking them to do so.

Mr. Charles F. Thatcher, speaking as a practical brewer, and from the experience gained during the last eighteen or twenty years, said: Some years since, when in the West of England, I was advised by a well-known authority on brewing to use bone ash as a yeast-food or stimulant; after giving it a comparative trial, extending over some weeks or months, failing to trace any direct beneficial result I discontinued the use of it. Now, with regard to Smyrna malt, I have had, I believe, a rather exceptional experience, as at the brewery before alluded to I produced all classes of ale and stout for a period of over nine months with *Smyrna malt alone*, combined with a certain percentage of *lævo-* or *dextro-saccharum.* The reasons which induced me to adopt this course were, first, economy; and, secondly, the satisfactory nature of the article produced. I believe I am correct in stating that the same principles are still continued at the brewery I refer to. An important point, as bearing upon the subject before us, is, that I always found the yeast obtained from fermenting wort in which Smyrna malt was employed, both vigorous, well-developed, and solid in character, and also abundant in quantity; therefore, taking into consideration the fact, as stated by Messrs. Salamon and Mathew, that this malt contains only a small percentage of phosphates, as compared with English malt, I think we may fairly assume, that beyond a certain point, phosphates are not necessary to the production and development of the yeast plant.

Mr. Shearer: It would be interesting to know whether Messrs. Salamon and Mathew had made any experiments with the view of determining the vigour of the yeast crops obtained in their miniature fermentations. The production of yeast fitted for continuing the successive fermentations was, to the brewer, a matter of the highest importance; and although fermentation was carried on with the object, primarily, of converting sugar into alcohol, the operation was one which by the formation of a yeast, vigorous and otherwise suitable, the continuance of the brewing operations in the immediate future depended. The authors of the present paper appear to have depended solely upon the measurement of the cells and their hereditary characteristics, as evidences of the fitness of the yeast for future pitching purposes. Would it not be desirable to have the more direct testimony afforded by pitching the collected yeast once more in wort and recording the results? In the first series of experiments, the authors dealt only with the effects of phosphates added in various proportions to what is known as Pasteur's solution. The results they obtained, upon fermenting the solutions just mentioned, the authors have expressed in terms of sugar decomposed, and although for many technical purposes this method expresses with sufficient accuracy the relative vigour of the yeast dealt with, yet it is to be regretted, in view of the disturbing influences likely to be present when carrying on fermentations upon such a small scale, that Messrs. Salamon and Mathew did not, in addition, record the increase in weight of yeast at the conclusion of each fermentation. The greatest objection to be raised to the first series of experiments was, however, connected with the nature of the solutions fermented. In the fermenting fluids were to be found none of the bodies present in the wort actually produced in the brewery. Albumenoids, peptones, principles derived from the hops, carbohydrates, even maltose, etc., were absent, so that little of practical utility could be adduced from the experiments, however interesting in themselves. We have to thank Messrs. Salamon and Mathew for continuing their experiments under conditions more closely approaching to those existing in the brewery. In the face of the results obtained, from which the authors draw the conclusion that the amount of P_2O_5 existing in the ordinary wort of the brewer (wort of about 1·060 sp. gr.) is always rather in excess of what is desirable for the most favourable results in the way of yeast development; it would be interesting to learn how these gentlemen can explain the apparent anomaly that yeast, which from any cause has become weakened, if pitched in *strong* wort, much stronger than ordinary, or normal 1·060, wort, is greatly strengthened, and that generally fermentations are more vigorous when yeast is pitched in a very strong wort, than when the same yeast is employed to excite fermentation in one of normal gravity. Yet accord-

ing to the deductions drawn from Messrs. Salamon and Mathew's results, wort of a gravity of 1·120, containing double the proportion of phosphoric anhydride, as compared with ordinary wort, and, therefore, a very undesirable excess of that body, would be ill fitted for the carrying on of a strong and powerful fermentation. As a matter of fact, however, brewers are in the habit of using strong wort for the purpose of invigorating weak yeast, and also for inducing a strong fermentation prior to pitching the bulk of the wort to be fermented. Messrs. Salamon and Mathew's statement that the P_2O_5 in the ash of yeast is present mainly as phosphate of potash may possibly be correct; but, if so, the phosphate must be of a very complicated formula, one that has hitherto been unknown, the ratio subsisting between the phosphoric anhydride and the potash not admitting of the acid and base being united to form any ordinary phosphate of potash

Dr. E. R. MORITZ said: From the results of Messrs. Salamon and Mathew's investigation, it appears that the addition of phosphates to the fermenting wort causes no increase in the quantity of nitrogenous matter absorbed by the yeast; but granting this to be so, there is yet one other point to be considered—viz, the quality of nitrogenous matter so removed. It has come under the notice of others and myself, that an addition of assimilable phosphates, applied in a manner specially adapted to the cases in question, has promoted the stability and clarification of beers, which without this addition were found deficient in these respects. This property has been most marked in the case of beers brewed with soft waters (especially those containing carbonate and sulphate of soda) and malts insufficiently exposed to high temperatures on the kilns. In the ordinary way, these circumstances would tend towards unstable and cloudy beer, but the addition of phosphates previous to the fermentation was found to produce a marked benefit as regards stability; and the conclusion to be drawn would be that the added phosphates, if not stimulating the yeast to absorb greater amounts of nitrogenous matter, caused it to assimilate that kind which specially favours the development of the microbes of beer disease.

Dr. W. S. SQUIRE said he fully agreed with Mr. Salamon in his view that malt worts contained sufficient mineral constituents for the growth of yeast. Pressed yeast contains from seventy to eighty per cent. of water, and the solid substance of yeast contains from six to seven per cent. of ash, consisting mainly of phosphate of potassium, with a certain quantity of the phosphates of magnesium and calcium; so that pressed yeast does not contain more than about two per cent. of ash. It happens that the composition of the ash of malt resembles in a rough sort of way that of the ash of yeast, and of this ash, malt contains about two per cent. It is evident, then, that if the whole of the mineral constituents of the malt passed into solution, they would be sufficient to produce a weight of pressed yeast equal to that of the original malt. Of course, the whole of these mineral constituents does not pass into solution, but a considerable proportion does. It is chiefly the calcium and magnesium salts which remain behind, while the greater part of the phosphate of potassium dissolves. In any case, the wort will contain mineral matter amply sufficient for the quantity of yeast which would be obtained under normal circumstances. Of course, this would be somewhat different if large quantities of sugar containing little or no phosphates were added to the wort. I am speaking of beer worts, and a fermented solution of sugar is not, in my opinion, beer. Even in distilleries where a considerable proportion of raw grain is used in the composition of the worts, a very large crop of yeast, as much as eight or nine per cent. of the materials used, may be obtained by particular management, without any addition of mineral matter. This is generally known as pressed or German yeast, and is in no way inferior to beer yeast, produced under the most favourable circumstances. On the contrary, it is far more active and healthy than beer yeast, and is on that account preferred by bakers and confectioners. I am, therefore, of opinion that the addition of phosphates is totally unnecessary for the manufacture of beer from malt and hops. What it might be necessary to add, when a fermented liquor other than beer (though bearing that name) is prepared from materials other than malt and hops, I am unable to say.

The CHAIRMAN said: It is now my pleasing duty to conclude the discussion. I think we must all be of opinion—no matter how we may differ in our interpretation of their bearing—that the authors have made a valuable contribution to the chemistry of fermentation. The numerous analyses made must prove of use to many of us hereafter for reference, and assistance in other work; and while I congratulate the authors upon their valuable work, I hope they will continue their investigations. In regard to the use of phosphates, I agree with the authors, at least with reference to worts from well-harvested barleys and well-grown malts, but where large quantities of sugars, whether cane, invert, or of starch origin, are used, I have found the occasional use of phosphates beneficial. The authors have misunderstood the bearing of the empirical deduction made by me from the moist combustion process as applied to malt worts and beers. This process gives results, which have no relation to those obtained by the soda-lime process, which, though not giving the absolute nitrogen in all cases, still gives much more than the Wanklyn method. In my experience of malt analyses, I have found the Wanklyn *albumenoids* to be a useful factor, taken with many others, in arriving at a practical conclusion as to the merits of various malts for different kinds of beers. I beg to move, gentlemen, that the thanks of this meeting be given to the authors for their valuable paper, which I hope may be followed by further contributions.

Mr. SALAMON said, in reply: The experience of Mr. Thatcher with Smyrna malt is of great interest, when considered with reference to our paper; because, as he states, it clearly shows that good results may be obtained from a malt abnormally low in phosphorus. It will also generally be found that the soluble nitrogen of a Smyrna malt is of low percentage; much lower indeed, in many cases, than the sample the analysis of which we have recorded. This would seem to give the key to the whole question—viz., that high soluble nitrogen and high phosphorus indicate a malt grown upon a highly cultivated land; but it by no means follows that such malt is the best for brewing purposes. Indeed, there is a very increasing opinion that much of our land is over-cultivated for purposes of barley growth. Smyrna malt is generally used, in this country, for blending. May it not be that one of its functions is to dilute the amount of phosphorus present in malts derived from very highly cultivated land? Mr. Shearer asks if we have pitched with the yeast obtained in our laboratory fermentations? I do not hesitate to say we have not done so. It would have been obviously ridiculous to have attempted to pitch upon such a scale with yeast so produced. If gentlemen present this evening have any doubt as to phosphate-treated wort producing better pitching yeast than ordinary wort, it would be well for them to repeat our experiments upon the large scale. It is in this way that the brewer

can lend a helping hand to the chemist. But it is necessary to see that the conditions are under control. For instance, I have been in several country breweries, where they looked favourably upon the addition of solutions of phosphates to fermenting worts. I questioned them as to their mode of use; and found that, in every case, they added them to the wort, when the attenuation was about half completed. In fact, they roused the solution into the wort, thus re-aërating it, and so re-invigorating the yeast. It is scarcely necessary to add that the appearance of a more vigorous crop of yeast does not, under such circumstances, indicate that it is due to the addition of phosphates; but it does show that no scientific attention was paid to the details of the work. If we have proved, that the addition of phosphates does not affect the size or appearance of the yeast cells, that the thickness of its walls remain unaltered; that no more, and sometimes less, alcohol is produced in a given time; that no more, and sometimes considerably less, nitrogen is removed from the wort, this nitrogen so removed having been found to be a rigid measure of the yeast produced; that no matter how much phosphorus is added, the same amount, or practically the same amount, is removed from the wort, and no more,—then, granting the accuracy of our observations, it would indeed require very strong practical testimony to effectually contradict them. The fact that weak yeast revives under treatment with strong wort is surely no proof that its revival is due to the presence of the phosphate. Mr. Shearer complains that our experiments upon Pasteur's solution were made under conditions which had no relation to malt worts in a brewhouse; that we did not in that instance take into consideration the influence of the carbohydrates and of the various nitrogenous constituents of a wort; but if his contention hold good in that case, it must be equally applicable to the one he cites; and I can best answer his question by asking him how he will deny the possibility of the increased quantity of these bodies providing additional nourishment for the yeast; and, moreover, holding the increased amount of phosphates in check, and thus preventing them from exerting any injurious influence. At any rate, we have proved that, under ordinary conditions, they do no good; and it is difficult to see why the experiment he cites should prove an exception to a rule which we have found to be so constant. Mr. Shearer is in error with respect to the phosphate of potash. We have only stated that it is generally returned as phosphate of potash existing in the ash; but inasmuch as we commenced by stating that the exact condition of the existence of phosphorus in yeast was unknown, we have throughout alluded to it as phosphorus in combination. Dr. Moritz has alluded to experiments which he has made, inducing him to think that phosphates exert an action favourable to the removal of certain kinds only of nitrogenous matter. It is to be regretted that he has not seen fit to publish the result of these experiments; for if he has, as he states, made this discovery, he has mastered the very facts and gained the very information for which brewers have so long been waiting. If Dr. Moritz has found out what kind of nitrogenous combination it is, which produces stability in beer; and what kind it is that induces an opposite effect, then, in view of the importance of the subject, he is scarcely justified in keeping the information to himself; and I submit that he should be induced, at an early opportunity, to communicate the results of his experiments to this Society. If his remarks are merely inductive, and are not derived from absolute experiment upon the nitrogenous matter, then in view of the many experimental proofs we have offered to the contrary, and of the fact that he has submitted none at all in support of his contention, I do not think it will be necessary to trouble the meeting with further criticism respecting them. I am glad to find that Professor Graham's views upon the question of phosphates are practically identical with our own. As regards the matter of the soluble albumenoids, we are content to let our results speak for themselves. They were certainly made without bias on either side; and Mr. Wilson's past experience is certainly not to be ignored in the matter, especially as he states that in no case was there any room for hesitancy or doubt. I do not, however, wish to dogmatise upon a subject still involved in difficulties, and I hope that before long I may be in a position to contribute some further information bearing upon this question to the Society.

ADDITIONAL NOTE ON ALUMINA IN SUPERPHOSPHATE.

BY H. B. YARDLEY.

Some time after the publication of my paper on this subject in the Society's Journal of August, 1884, it was suggested to me that a sufficient period had hardly elapsed between the tests of the mixtures.

Having the experimental samples still by me, I again retested the principal ones, with results stated in Table 1 as nine months after making. I also made the further experiments given in Table 2.

TABLE 1.

	Insoluble P_2O_5					Free acid, calculated as SO_3				
	No. 5.	No. 7.	No. 9.	No. 11.	No. 12 (with Fe_2O_3).	No. 5.	No. 7.	No. 9.	No. 11.	No. 12 (with Fe_2O_3).
Immediately after making...	0·17	0·35	6·89	0·40	1·71 ...	8·67	3·94	0·48	not detd.	4·06
One month ,, ...	0·23	0·48	9·16	0·35	2·43 ...	8·18	3·75	0·48	,,	2·58
Nine ,, ,, ...	0·17	0·84	10·80	0·40	3·43 ...	7·72	3·76	0·55	3·36	1·58

TABLE 2.

Mixture.	No. 13.	No. 11 (similar to No. 7).
Grains pure tricalcium phosphate	200	200
,, calcium carbonate	50	25
,, alumina hydrate	22·5	12·5
,, silica	22·5	12·5
	295·0	250·0
Grains chamber acid 115° T.	270·0	250·0

Gave on testing—

	Insoluble P_2O_5		Free acid, calculated as SO_3	
	No. 13.	No. 14.	No. 13.	No. 14.
Immediately after making ...	1·92	0·71	3·05	4·36
One month ,, ...	2·04	0·81	2·47	4·00
Three months ,, ...	2·45	1·02	1·28	3·20

All of these confirm the conclusion drawn in the first instance—viz., that *provided there is a sufficiency of free acid in the manure, no reduction takes place from the presence of alumina.*

In No. 13 the alumina will be seen to be in very large quantity (11¼ per cent. in the phosphate) and the acid insufficient, hence the slight reduction in this case.

I may as well state that the free acid was determined by alkalimetry to complete neutrality as indicated by cochineal. In presence of iron and alumina there is always a faint cloudiness after the first few drops of alkali are added, which scarcely increases until the liquid becomes alkaline. In commercial superphosphates I have found this cloudy precipitate consists wholly of phosphate of iron, but in the experiments containing alumina a similar cloudiness occurred, which, however, I did not test, but the presumption is that it was phosphate of alumina, as those containing neither iron nor alumina gave no precipitate whatever until alkalinity was reached.

In conclusion, the condition of the samples No. 7, *et ult.*, was very good indeed, and even No. 5 was not so wet as might be expected from the large excess of acid.

DISCUSSION.

Mr. T. W. B. MUMFORD gathered from the author's figures, given now and in his former paper, that in the ordinary method of manufacturing superphosphates in saleable condition and free from excess of sulphuric acid, the presence of iron and (or) alumina in the raw material, tended after the lapse of a short time to render its equivalent of monocalcic or soluble phosphate insoluble. It certainly had been proved beyond question, whatever might be the deduction which the author could draw from his experiments, that when iron and (or) alumina were not present no diminution in the solubility of a superphosphate took place, even after storage for some years.

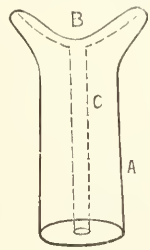
Mr. HUGHES asked whether the author considered that his experiments afforded evidence that alumina was an unobjectionable constituent of mineral phosphates in the face of the contrary view held by manufacturers at the present time. The figures on the board went to show that no reversion into the insoluble state took place so long as a large excess of "free acid" was present. What did the author mean by "free acid"? Surely 4 or 5% of free sulphuric acid would completely unfit a manure for storage, and indeed all agricultural purposes. What practical value could experiments have which depended on a physical condition of the superphosphate impossible in practice!

ON A NEW FORM OF PETROLEUM LAMP.

BY PERCY F. FRANKLAND, PH.D., B.SC., F.C.S., ASSOCIATE ROYAL SCHOOL OF MINES.

THE rapid advances which have been made during the past twenty years in the construction of petroleum lamps has resulted in the almost exclusive use of mineral oil in all places where gas is either out of reach or not desired. The use of colza lamps in the house is now almost solely adhered to by timid persons who regard petroleum with suspicion, and who, therefore, prefer to remain satisfied with the inferior light, great cost, and unnecessary labour which lamps consuming vegetable oils entail. Colza and other fatty oils, however, still retain their place in lamps of another class, such as railway lamps, hand lanterns, and the like, owing to the difficulty which is experienced in burning mineral oils in places exposed to draught and violent vibrations, or in lanterns in which the use of chimneys is inadmissible.

I have the pleasure of bringing before the notice of the Society a form of burner which has been specially designed for the consumption of mineral oil in lamps of this latter class, and which possesses some points of interest and novelty.



This burner consists of a hollow porcelain cylinder (A) from 2-3 inches in length, the upper extremity (B) of which is flattened and has a notch cut in it. The interior of this cylinder is fitted with a mixture of plaster of Paris and charcoal, and its axis is penetrated by a glass tube (C) about ⅛-inch diameter, which serves to hold the wick. This cylinder is cemented into a metal screw which fits on to the oil reservoir, so that the lower extremity of the cylinder almost touches the bottom of the reservoir. The wick used is a mere cotton string, the thickness of which is practically immaterial, and is so arranged as to very slightly project in two or more loops above.

When the lamp is first lit it burns but dimly, until the porcelain cylinder becoming strongly heated the flame gradually enlarges, expanding in the direction of the flattened upper extremity of the burner, the height of the flame depending upon the extent to which the wick projects. The flame produced is flat and slightly pointed towards the top, and the height should be so arranged that it is just below the smoking-point. When thus adjusted, the lamp continues to burn without any attention until the last drop of oil in the reservoir is consumed, the illuminating power remaining nearly constant throughout.

A charge of 4 fluid ounces of kerosene oil was found to last 13 hours, and the light yielded towards the end of this period amounted to 0·93 standard candle. In other words, 1 fluid ounces of kerosene when burnt in this lamp produce a light of one candle for 12·09 hours, or 1 gallon of oil will give a light of 484 candle-hours. The oil used was the best kerosene, flashing at 107° F., and obtainable for 10d. a-gallon; 484 candle-hours would thus cost 10d., or 12 candle-hours about one farthing. This is not so cheap as the light yielded by petroleum lamps provided with a chimney, for I found that the smallest and commonest lamp of this kind which I could purchase, in which the wick was ⅓-inch in width, consumed 4 fluid ounces of kerosene in 12·25 hours, giving during this period an average light of 1·44 candle; 1 gallon of kerosene burnt in such a lamp would give 706 candle-hours, or 12 candle-hours could be obtained at a cost of 0·17d.

I have also compared the cost of the light obtained from the new burner with that yielded by a colza-oil lamp without chimney. This lamp, which was provided with a ½-inch wick, was allowed to burn for thirteen hours, and at the end of four hours it was giving a light of 0·86 candle, whilst at the end of twelve hours the light had fallen to 0·21 candle. Assuming, how-

ever, that the light of 0·86 candle had been maintained for thirteen hours, then 4 fluid ounces would yield 12·92 candle-hours, and 1 gallon 517 candle-hours; taking the price of colza-oil to be 2s. 9d. a-gallon, the cost of 12 candle-hours would be 0·77d., or more than three times as much as the cost of the same light produced by the new burner with kerosene oil.

The new burner gives a flame which is not extinguished even when exposed to exceedingly violent vibrations and shocks, a circumstance which renders it particularly fitted for lanterns and carriage purposes. The light appears to be a perfectly safe one, and all experiments undertaken with a view to producing an explosion of the petroleum vapour and air inside the reservoir proved unsuccessful. Thus the burning lamp was heated in an air-bath so that the oil in the reservoir was at 138° F., and although the flame was violently blown about by the currents of air no flashing of the petroleum-vapour took place, notwithstanding that only a small quantity of oil had been put in the reservoir so as to leave a large air-space, and thus facilitate the formation of an explosive mixture.

A weak point in the lamp is that a small amount of petroleum-vapour escapes combustion and causes a slight smell; this is, however, of comparatively little importance, as the lamp is not intended for use indoors.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: Prof. J. Campbell Brown.

Committee:

Eustace Carey.	A. Norman Tate.
John Hargreaves.	J. Affleck.
E. Milner.	J. C. Gamble.
C. Symes.	Douglas Herman.
F. Hurter.	Alexander Watt.
H. Brunner.	W. P. Thompson.

Local Sec.: E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

University College, Ashton Street, Liverpool,

MR. E. K. MUSPRATT IN THE CHAIR.

SUMMARY OF PAPER ON THE PRESENT POSITION AND FUTURE PROSPECTS OF ELECTRIC LIGHTING.

BY A. BROMLEY HOLMES, ASSOC. M. INST. C.E.

The author first pointed out the advantages of electricity over gas and oil as a source of light indoors, owing to the fact that no oxygen was consumed and all noxious products of combustion were avoided.

The manufacture of electricity on a large scale was stated to be much simpler than that of gas, the difficulties of electric supply being chiefly the absence of practical means of storage and the cost of distribution.

Primary batteries would be of great use in small installations, and the accumulators at present obtainable were very imperfect. Electrical engineers naturally looked to chemists for the improvement of primary and secondary batteries, and the progress made in this direction at present was lamentably small.

The methods of generating electricity for lighting purposes were explained, and the various classes of dynamos were described, together with the devices employed to make these machines self-regulating so as to automatically adjust themselves to a varying number of lamps.

It was mentioned that machines were now made so perfect in this respect that it was possible to turn out 99 lamps out of a hundred without affecting the brightness of the remaining one lamp.

The storage cells at present in use were stated to consist generally of glass or earthenware vessels, containing in a dilute solution of sulphuric acid one or more pairs of lead plates, the surfaces of which have been oxidised by the action of an electric current or otherwise. The charging current from the dynamo causes the formation of peroxide on one plate, and reduces the surface of the other to a less oxidised condition. When the dynamo is disconnected, and the cells are coupled up with the lamps, the current flows in the reverse direction to that of the charging current. To increase the storage capacity of the lead plates, they are sometimes perforated, and the holes so formed filled up with oxide of lead.

The desiderata in an accumulator are, moderate first cost and reasonable durability, combined with a high electro-motive force, low internal resistance, and considerable storage capacity.

A hope was expressed that members of the Society of Chemical Industry would direct their attention to this important detail connected with the advance of electric lighting.

The principle of action of arc lamps and incandescent lamps was fully explained, and also the various plans of coupling up the lamps for work.

The difficulties connected with the distribution of electricity were alluded to, and also the means adopted to overcome these obstacles.

It was mentioned that the electric light was now being supplied from central stations at a cost from one and a-half times to twice that of gas of equal illuminating power, and the author indicated the directions in which the cheapening of the electric light was possible, and concluded by stating his belief that within a limited period incandescent lamps would be obtainable, so far improved in efficiency as to bring the electric light within the reach of all.

DISCUSSION.

Mr. Simpson said: He always had been surprised at the blind support given by the public to all sorts of electrical schemes, more especially in connection with accumulators. Sir Wm. Thompson had pointed out that in charging and discharging these latter there was a loss of power of about 25%; and in the case of tramcars propelled by them this loss even amounted to 50%, without any counterbalancing advantage. Dynamos too seldom gave a return of more than 85% of the power expended. He would, however, be glad to see the large dynamos in use mentioned in Mr. Holmes' paper. He had himself gone to some expense in electrical experiments on caustic soda, but the want of a diaphragm capable of withstanding its action caused the experiments to be abandoned.

The Chairman asked Mr. Holmes if electric lighting had made commercial progress. He thought that in the future, electricity would play a part in chemical operations in spite of the unfortunate experience of workers like Mr. Simpson. A member, who had visited some electrolytic works in London, had been favourably impressed with what he saw there. Messrs. Siemens had also fitted up plant in Germany, by which electricity did the work of scrap-iron in the wet-copper process, but the large capital outlay required had hitherto prevented its adoption for that purpose in England. He had also read lately of an improved primary battery, of a portable nature, capable of supplying light on a small scale.

Mr. Thompson suggested the use of aluminium in primary batteries. By the action of caustic soda a very considerable temporary effect was produced, but the rapid destruction of the metal had hitherto stood in the way of complete success.

Mr. Holmes, in reply, said that recent experience had hardly confirmed the anticipations formed with regard to accumulators. He had calculated that 18,000 tons of accumulators would be required to take the place of engines of 3000 horse-power in the case of Atlantic liners. With tramcars the case was better. To work a tramcar for five hours, a ton weight of accumulators would be needed, and would replace, say, two horses. To this must be added the weight of the dynamo, which was comparatively small. There was no reason why a tramcar should not carry storage batteries sufficient to propel it for three or four hours, and this had often been tested in practice in London and elsewhere. As to cost, a steam-engine was far more economical than horse-traction. Suppose that a steam-engine were put down at the tram stables to accumulate the electricity, they could change batteries as quickly as horses—even more so, were they to adopt the simple expedient of running the accumulators in trams under the cars.

Mr. Simpson: Would not compressed air do better?

Mr. Holmes: The cost of plant had prevented this having a fair trial up to the present. Then, in Liverpool, see how the tramways were laid, and the cruel strain put upon the horses to start the cars, the latter of which would be obviated by the use of electricity. Mr. Simpson wished to know what horse-power would be required to work these large dynamos. The largest in Liverpool now was at Messrs. Tait's sugar refinery, and showed to what perfection these engines had been brought, for it started a month ago, had worked continuously ever since, and was in perfect order now. He thought that a machine capable of running 600 lights would soon be made. Messrs. Siemens would have in the Inventions Exhibition three dynamos, each producing 300 lights and driven direct by three pairs of high-pressure and low-pressure engines. In practice about eight lights could be run per horse-power. Regarding the commercial side of electric lighting, taking for granted that the steam-engine is about as good as it can be, and that water is to be had for the pumping, then the dynamo would utilise about 90 of the power, and no better than that could be done. As to the mains, there must be a central station, from which they should be laid so as to annihilate distance as much as possible. Edison had tried an ingenious plan called the "three-wire system," but in Liverpool it would be necessary to adopt the "parallel system" for simplicity's sake. Even with this occasional breakdowns occurred, as in everything where dependence had to be placed on inexperienced persons. As to the incandescent lamp, he believed it had a great future, but there was great scope for economy yet. The cost per light could be reduced to one-half of that formerly incurred.

Manchester Section.

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Vice-Chairman: I. Levinstein.

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John Morrison.	T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

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Erratum.—In the May number, vol. iv. [5] 312, nineteenth line from top of first column, *for* "multiplied by two," *read* "multiplied by four."

Birmingham and Midland Section.

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Vice-Chairman: W. A. Tilden.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

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Nottingham Section.

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Vice-Chairman: Lewis T. Wright.
Treasurer: J. B. Coleman.

Committee:

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W. H. Carey.	H. J. Staples.
W. A. Curry.	E. B. Truman.
H. Doidge.	J. F. Warwick.
S. E. Field.	R. L. Whiteley.
R. Fitzhugh.	

Hon. Local Secretary:
J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

INAUGURAL MEETING.

The proceedings of this Section were inaugurated on Friday, June 5, by a Conversazione, in the University College, Nottingham, which attracted a

numerous assemblage. In the Chemical Laboratory was placed a series of exhibits collected by the various members of the local committee, illustrating some of the industries comprised in the Society's programme, and which included various methods of lighting by gas and electricity, coal-tar and other colours, analytical and optical apparatus, and many other objects of chemical and scientific interest, all of which reflected great credit on their exhibitors.

At eight o'clock an inaugural address was delivered by the Chairman, Professor Clowes, in the large lecture theatre of the College.

Professor Clowes said: It falls to my lot, as the present representative of the Nottingham Section of the Society of Chemical Industry, to address a few words to you this evening. And speaking, as I do, not only to members of this young, and I trust vigorous Society, but to friends who have honoured us with their presence, my first duty is certainly to give to our guests in the name of the Society a most sincere and hearty welcome. We will venture to hope that many of you will, at future gatherings of this kind, have exchanged your present condition of guests for that of entertainers—a change which our Secretary will, I am sure, do his utmost to facilitate. And now, speaking to a gathering of friends interested in the progress and welfare of chemistry and of chemical industries, and met together in this capacity probably for the first time, and in a somewhat informal manner, I trust you will allow me to depart from the formality of an ordinary President's inaugural address, and to state to you in a brief and simple manner our reasons for starting this Society, and the directions in which we hope and expect that it will be useful to Nottingham and the surrounding towns and district. History tells us that in early times men worked most indefatigably, but in a somewhat haphazard manner, to improve and discover various processes of manufacture; their main object being, not so much the discovery of the secrets and laws of nature and the benefit of mankind, as the improvement of their own finances. In later ages many men of energy and intellect have placed before themselves in their labours a more lofty and less selfish aim; they have spent themselves in attempting to learn what are the unchangeable laws of nature. At first sight it might appear that these two classes of workers had little in common; and, unfortunately, this opinion has always in some degree existed, the natural philosopher engaged in prosecuting his researches being almost contrasted with the energetic and intelligent manufacturer endeavouring to improve and discover processes; or, as it is put in the present day, the *theoretical* man is too often considered to be out of touch with, and to have nothing in common with, the *practical* man. It must, however, be very evident to those who will carefully consider the case, that the interests of both these classes of workers are to a great extent identical: thus, only can the practical man work most surely, most directly, and most economically when he works with a knowledge of nature's laws; equipped with this knowledge also, he is in a better position to insure advance and improvement. We are told on the highest authority that England is suffering in competition with some of her Continental neighbours, by not appreciating as fully as they do the advantage of blending theory with practice, and the necessity of the co-operation of the scientific and practical man. In what way it is best to blend in chemical training the scientific and the technical elements, will certainly be debated in our new Nottingham Section of the Society of Chemical Industry, as it has been already discussed in many other similar societies in this country. I may therefore leave this subject for the present, with the remark that it is one of paramount importance to the success of this town, and of the greatest interest to me personally in my capacity of a chemical teacher in your midst. But fortunately there are already in Nottingham and its neighbourhood men who fully appreciate the importance of enabling the rising generation to engage in our important industries with a knowledge of the scientific principles which underlie them, and who desire to aid this enterprise by every possible means; there are also not a few who have already passed through a very creditable scientific training in this building or elsewhere, and we have several gentlemen here this evening who are carrying on large and important industrial enterprises with a sound knowledge of scientific laws and principles. Representative men of these various classes have agreed that by associating themselves together, and bringing forward for discussion matters of novelty and importance, much may be done towards mutually aiding and informing one another, and towards arousing and stimulating a desire for the advantageous blending of theory with practice. Nottingham has already societies of a scientific character. The one which appears to be most nearly allied to our own is that known as the Chemists' Association. Its main object is, I believe, to secure efficient training to the pharmaceutical apprentices of this town, and those who best know the important and necessary work it is doing will most earnestly support this Association and endeavour to secure its permanency. But it will be evident to you that our Society should embrace many applications of chemistry besides pharmacy, and should gather in the trained and experienced as well as the student and the novice. There is then, as far as I can see, no existing association in this district with which we shall compete, whilst there are several societies, many members of which we should embrace. In comparison with the largest industrial centres of this country, Nottingham of course does not contain a numerous population, but the size of our town is decidedly respectable; it has increased considerably of late, and we are loyal enough to believe it will yet increase much more largely. Still, the question has been asked, Can we maintain a Section of the Society of Chemical Industry? I am sanguine enough to say undoubtedly we ought to do so, and that we will certainly make the attempt. But fortunately we have this great advantage, that we can start in connection with a large and important Society already organised, which will aid us financially, by its prestige, and still more by furnishing each of our members with a monthly Journal, which is unequalled as a record of the industrial chemistry of the civilised world. This Society further accords to each member of the Nottingham Section the privilege of attending its own meetings in London, as well as the sectional meetings in other large towns in the United Kingdom. We are therefore members of a large confederation, whose object it is to study, discuss and record the improvements and progress in applied chemistry, and in all matters related thereto; and I need not point out to you how greatly this may further our own personal ends, and, better still, how it may promote the efforts now being made to promote and maintain the supremacy of this country in the many industries involving the application of chemistry. For personal, as well as for patriotic reasons, this Society has therefore powerful claims on your co-operation and support. Some of you may ask what industries in the Nottingham district are capable of being advanced by a knowledge and application of chemical principles. Well, really the difficulty in answering this question arises rather

from the doubt as to which industries can fairly be omitted. However, to name some of the principal, we have the manufacture of gas and the utilisation of its residuals, the bleaching and dyeing processes, colour making, pharmacy, brewing, baking, tanning, iron smelting, coal mining, and, as I have already said, a host of others in which chemical knowledge must be of great advantage. But whilst chemical principles are thus widely applicable, it will be readily granted that applied chemistry cannot be divorced from scientific chemistry, from physics, and from mechanics, and we therefore invite and welcome into our Society those who can best aid our discussions from the physical and mechanical side, although our discussions will probably mainly be on applied chemistry. And I therefore do not hesitate, in the name of the Society, to invite communications of a purely scientific character, as well as papers on applied physics and mechanics. Our vast metropolis may support separate and distinct associations of scientific chemists, industrial chemists, scientific physicists, telegraphic engineers, and civil and mechanical engineers, all more or less distinct in their objects, but also more or less merging into one another. Such a sub-division would be at present impossible in our own town; but may we not fairly embrace in our Society of Chemical Industry the consideration of matters chemical, mechanical and physical, whether in a purely scientific way or in their applications, and make the Society for this town at least representative of what we may term the industrial sciences? Surely this blending of aims would be desirable. With regard to the advantages of association, few of us need any information. In one sphere or another we must surely have felt the wholesome emulation and stimulation derived from mingling with those of kindred aims and pursuits, especially when the common aim is that of advancement and improvement. And here let me say a word respecting what, to some, may appear a fatal hindrance to such association amongst those who are engaged in a keen competition and rivalry in their industrial pursuits. It is frequently urged that important trade secrets may be divulged, to the detriment of the individual, and to the advantage of his rival. True science has no secrets; the aim of the scientific man is to learn fresh truth, and to scatter it broadcast. On this side, therefore, you *must* be gainers by association with men of scientific training, thought, and habit. And surely, regarding special unpatented processes, our very interests would for the time keep us silent. There are few of us who have not frequently to harbour a secret; and if we are successful in doing so elsewhere, why not in our Chemical Society? It cannot be maintained that the advances in industrial science are invariably or even mainly for any length of time in this secret state; and if we help to keep each other informed of the open and published advances, and develop by discussion their important bearings, we shall find plenty of most important and useful occupation in our meetings. May we not also look for advantage from the association of teachers with old students, both gaining thereby ideas of the practical and broader application of scientific laws and principles.

The whole Society of Chemical Industry assembles every summer alternately in London and in some important provincial centre of industry. These gatherings serve partly as conferences, but they also enable members to visit important works of various kinds, and of the most approved and modern types. Last year a most important visit was made to the industries of the Tyneside. This year the meeting will be held in London in next July, and will naturally find its quarters in the neighbourhood of the Inventions Exhibition, in which not a few members of the Society are exhibitors. This will doubtless prove an attraction. It is hoped that the members of our local Section may be able to obtain in their own district the practical education given by visiting model industrial works; and an attempt will be made, from time to time, to organise such a system of *field instruction*, as the naturalist would term it. We shall be thankful to receive invitations from the proprietors and managers of large works, and shall quite appreciate their kindness in allowing us to see of their best. And now I have placed before you our ideas regarding the infant, at whose formal christening you are present this evening. If you like his looks, and think he shows promise of developing into a useful member of society, do not stand aloof; but, by constantly showing the interest you have evinced in his cradle days, aid his growth into a strong and useful member of your community, and give those of us who look upon the babe with proud and partial eyes of parents and sponsors, reason to rejoice over his rapid development and useful career.

On the motion of Mr. LEWIS T. WRIGHT, a vote of thanks was passed by acclamation to Professor Clowes for his able address, and to the Chairman and Committee of the College for their courtesy in granting the use of the building.

After the address, Mr. LEWIS T. WRIGHT described in detail the various gas lighting arrangements shown in the laboratory, and exhibited a series of models of gas works and processes. At the same time Mr. A. H. SIMPSON was explaining in another part of the building systems of lighting by electricity, illustrated by various types of dynamos and lamps, both arc and incandescent.

Addresses on Tussur Silk, by Mr. T. WARDLE; on Luminous Paint, by Mr. J. B. COLEMAN; and on Dyeing and Bleaching Processes, by Mr. R. LLOYD WHITELEY, served to complete the interest of a most enjoyable evening.

Bristol and South Wales Section.

Chairman: Prof. W. Ramsay.

Vice-Chairman: P. J. Worsley.

Committee:

R. W. Atkinson.	W. Pringle.
G. Dobson.	Albert E. Reed.
A. C. Fryer.	G. S. Schacht.
Thos. Morgans.	W. A. Shenstone.
A. C. Pass.	C. M. Thompson.
F. Player.	W. Windus.

Local Secretary and Treasurer:

E. G. Marks, 9, Nelson Street, Bristol.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Ebullition of Water considered in regard to Steam Engines. H. Walther-Meunier. Bull. Soc. Ind. Mulhouse, 1885, 113.

THIS is a discussion of evidence from various sources as to the cause of boiler explosions. The ebullition of water, from this point of view, has been investigated by Donny (Ann. Chim. Phys. [3], 16, 177, 1846), Dufour (Archiv. Bibliothèque Univ. 1864, and Pogg. Ann. [5], 4), Kayser (Zeits. Verein. Deut. Ing. 9 and 10), Cohn (*Ibid.* 14), and Gernez (Ann. Chim. Phys. [5], 4). By their experiments two main results are established:—(1) for the production of the phenomenon of the super-

heating of water, the condition of perfect repose of the liquid mass is indispensable; (2) the presence of minute quantities of gases is sufficient to maintain a normal ebullition. These considerations are applied in an exhaustive discussion of the conditions of ebullition in steam generators of the various types now employed, which, the author shows, are such as to practically exclude the possibility of superheating. He maintains, on the other hand, that boiler explosions are referable either to defects in materials or construction, or to want of observation of necessary precautions.—C. F. C.

On the Construction of Boiler Chimneys. P. Huth. Chem. Zeit. **9**, 692.

A DISUSED chimney, 20 metres high, 0·5 metre lower, and 0·35 metre upper diameter, was connected with a boiler 8 metres long, 1·6 metre diameter, with an inner flue 0·5 metre diameter, the total length of flue being about 30 metres. The chimney was found inefficient, and a new one was built, the length of flue being 29 metres, and the width at least 0·65 metre square. With the increased dimensions of flue, a chimney 12 metres high was found to be fully equal to the former chimney of 20 metres, and when it reached 16 metres it was again tested and found fully efficient; the smoke being white, free from soot and flue dust, and the heating effect of the boiler excellent. The coal used was also reduced 15 to 20 per cent. The damper was only required to be one-quarter open. The principal factor therefore to be considered is not only the height of a chimney, but also its proportional width. High chimneys are, on the whole, too narrow, and it would be useful to determine the most effective relation of height to width in the construction of chimneys.

—J. B. C.

Improvements in the Process of and Apparatus for Producing Cold. J. H. Johnson, London. From J. C. Rossi, U.S.A. Eng. Pat. 8777, June 10, 1884.

The apparatus consists of a series of two or more concentric annular vessels, provided with stirrers, the outer vessel containing the vessels of water or the liquid to be cooled. Nitrate of ammonium, equal in weight to the water in the vessel, is dissolved in the innermost vessel with agitation. The solution of the salt may be recovered by evaporation. The cold in the liquid finally discharged is recovered by causing it to cool either air or water to be used in the various parts of the machine.

—C. C. H.

An Improved Non-conducting Composition for Protection Against Heat. S. P. Wilding, London. From Wörth & Co., Ludwigshafen, Germany. Eng. Pat. 9063, June 17, 1884.

THE inventors aim at producing a non-conducting composition, the bases of which is granulated cork, in a condition in which it can be painted or coated on to the surfaces it is intended to protect. Such a composition is light, tough, highly elastic, and a very bad conductor of heat. They proceed as follows:—40 parts well-loosened asbestos fibre is mixed in a wet condition with 150 parts fossil meal, to which has been added 3 parts clay and 2 parts solution of soluble glass; the whole is intimately mixed with 150 parts of disintegrated cork. The mixture is dried quickly at a temperature of 100°, and the cakes ground fine. When the composition is used it is mixed with water into a thin paste, and applied to the heated surfaces with a brush. The patentees claim the manufacture of a non-conducting composition substantially as described.—C. C. H.

Apparatus for Drying in Vacuo. H. J. Haddan, London. From E. Passburg, Moscow. Eng. Pat. 1997, February 12, 1885.

THE apparatus described in this specification is an improvement on that described in a former specification for effecting the same work. The vacuum vessel is a horizontal cylinder, steam-jacketed on the exterior, and also heated in the interior by an annular cylinder capable of being heated by steam and revolving on trunnions. The exterior of the annular cylinder is provided with arms for the agitation of the material under treatment. The untreated material is fed into one end of the cylinder from a vessel which is isolated by a valve, when necessary, so that the introduction of fresh liquid does not destroy the vacuum. The evaporated material is removed from the other end on the apparatus by a similar appliance, so that the working is continuous and without a break. The whole apparatus and its several details is covered by six different claims.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Observations upon a Proximate Constituent of Coal. P. F. Reinsch. Dingl. Polyt. J. **256**, 224.

IN the course of recent observations upon the microscopic structure of coal, the author found that alkaline solutions dissolved out a certain constituent, leaving a large proportion of insoluble matter morphologically unchanged. The nature of the soluble constituent is now further investigated. By boiling coarsely-powdered coal with strong potash solution, diluting, and allowing to stand at rest for some time, a sediment is deposited, which contains the insoluble constituents, and which is suitable for microscopic examination. The supernatant, opaque, dark brown liquor is passed through a filter, saturated with a dilute acid, and the solution put on one side. After a short time a voluminous jelly-like mass of dark-brown colour will have settled down. The precipitate so obtained shrinks to one-tenth of its original volume when dried, is unaffected by concentrated sulphuric, nitric, and hydrochloric acids in the cold, is attacked by warm nitric acid with evolution of nitrous fumes, dissolves gradually and completely in ammonia solution, burns without swelling up when heated on platinum foil, leaving a slight residue, and evolving a small amount of ammonia. In the ordinary yields of the bituminous coal seams of Saarbeck, Ruhrbeck, Belgium, Silesia, Bohemia, Newcastle, Pittsburg, Indiana, Illinois, in so-called "whitecoal" and Tasmanite, the author has either failed completely to detect this soluble constituent by the above process, or has found it to be present in amounts certainly less than one per cent. In the leaf or paper-coal of the carbon formation of central Russia, this amorphous constituent has up to the present been found to occur most abundantly, several experiments giving 85 to 95 per cent. of insoluble matters, and 15 to 5 per cent. of the amorphous body soluble in alkalis, and precipitated from the alkaline solution by acids. This substance likewise occurs in the bituminous coal from Metschowk, which contains about 10 per cent. of the so-called "soot-coal," and the author considers it probable that it is present in many coals, but in such a form that it cannot be isolated by the action of alkalis alone.

—W. D. B.

The Utilisation of Coke-dust. P. Koehler. Chem. Zeit. **9**, 726.

THE dust left in gas retorts after withdrawing the coke, or accumulated at the bottom of long-standing coke heaps, when mixed with one-fourteenth its volume of soft clay, subjected to strong pressure and dried in the air, forms hard blocks of good combustible material, which may be transported without breaking up. J. B. C.

Improvements in the Manufacture of Gas applicable for Heating Purposes. Michael Cahen, Brussels. Eng. Pat. 11,335, August 15, 1884.

THIS is a process for the production of pure carbonic oxide gas by passing pure carbonic acid gas through coal or other solid fuel in a chamber externally heated. This chamber is built in three parts, the lowest being designed to hold the ashes and scoriæ, the middle one, wherein the conversion of the carbonic acid mainly takes place, and an extension, as it were, of this above for the introduction of coal, etc., and carrying off of the evolved gases. The middle part, where, of course, the heat is

most intense, is of fire-clay; the other two of cast-iron. When the carbonic acid is conducted into the glowing fuel it is not only converted into carbonic oxide, but it also assists in carrying off the hydrocarbon vapours and ammonia there disengaged. A good deal of the tar deposits on the cool fuel in the higher part of the generator, so that only the more volatile products escape with the carbonic oxide gas. These may be recovered by the usual means, in addition to which a passage through chloride of calcium solution is recommended to remove the ammonium carbonate. The pure carbonic acid used in this process is obtained by the combustion of the heating-gas, by subjecting the gaseous mixture to the pressure of one atmosphere in the presence of water, which under these circumstances absorbs 1·185 times its bulk of carbonic acid, against 0·016 time its bulk of nitrogen. The absorption is effected in a closed water-conduit, so constructed that the stream of water passing through it rises in one place to a height of at least forty feet above the level of the main body of the conduit. This column of water maintains in the horizontal portion of the conduit a minimum pressure of 1 atmosphere. From this elevation the water, having yielded up its carbonic acid, is brought down again, and kept in continuous circulation. It will thus be seen that the water in the lower portion is subject to a sufficient pressure to effect the separation of the carbonic acid and nitrogen. The latter passes away into the air by a pipe leading upwards from the conduit; this pipe, of course, being high enough to allow the required pressure to be maintained in the conduit. Circulation is kept up partly by the injection of the gaseous mixture, which it is desired to separate, and partly by a revolving screw. As the water moves upwards in the raised portion of the conduit it becomes subject to a reduced pressure, and the carbonic acid is disengaged. It is then collected by suitable means, and used as above for the production of carbonic oxide. The inventor gives figures showing by this process a saving of 74 per cent. on coke, and 65 per cent. on coal. Another most important advantage is that sufficient heat is generated by this pure carbonic oxide to enable a hot blast of air to be dispensed with under practically all circumstances.
—A. R. D.

Improvements in the Treatment of Petroleum. L. A. Groth. From Mrs. T. N. Flesch, Annweiler, Germany. Eng. Pat. 12,457, September 16, 1884.

To a litre of petroleum is added 500grm. of green vitriol, and the mixture is boiled for twenty minutes. This takes place at a temperature above 100° C. The liquid is now separated from the hard mass formed during the boiling, and mixed with twice its volume of petroleum. This yields a clear product without smell, which may be burned with safety, and gives a clearer and brighter light than ordinary petroleum.—A. R. D.

Improvements in Fire-lighters. E. G. Brewer. From Camille Navarre, Capelle au Bois, Belgium. Eng. Pat. 15,072, November 15, 1884.

Dry breeze, dry pitch, resin, petroleum, straw, refuse of flax, sawdust, chips of wood and cork, or other easily combustible materials, preferably in the proportion of 71 per cent. of resin, 15 per cent. of petroleum, and 14 per cent. of the other materials, are formed into a paste and moulded into suitable forms. Drawings are given of the shapes preferred. The lighters are bored with one or several holes to produce a current of air, that the combustion may be certain, whether the lighter be or be not covered with coal. For better ignition, wicks of some inflammable substance are provided.—W. D. B.

Improvements in Apparatus for Purifying Coal Gas. A. Dempster, Elland, Yorkshire. Eng. Pat. 2169, February 14, 1885.

A vessel of suitable size, shape, and material, standing preferably just after the condenser, is fitted with a pipe which enters at the bottom and extends to the top, its upper end being closed. This pipe has four or more lateral openings for the passage of the gas. Around the pipe are placed perforated plates, inclined at such an angle that the streams of gas impinge against the edges of the holes, and are roughly broken up. The gas is also washed here by a stream of strong ammoniacal liquor trickling down the inclined plates. Surrounding the inclined plates, and arranged in concentric rings, are a series of vertical plates, perforated with holes increasing in size the nearer they are to the inclined plates. These vertical plates are fastened to the main vessel at the top, and stand on chairs or supports at the bottom, being luted with the strong ammoniacal liquor. After the gas has passed through all the rings of plates, it leaves the chamber by a suitable exit hole. The ammoniacal liquor is fed in by a self-acting distributor.—A. R. D.

Improvements in Gas Producers. C. D. Abel, London. From F. Siemens, Dresden. Eng. Pat. 9103, March 16, 1885.

This invention applies to those gas producers wherein combustible gases are generated by the passage of a limited supply of air through incandescent solid fuel. Ordinarily the hydrocarbon gases evolved are so mixed with carbonic oxide that it is impossible to economically treat the mixture for tar, ammonia, etc. By this invention the gas producer is arranged in compartments which approximately separate the zone where hydrocarbons are evolved from the carbonic oxide zone. The hydrocarbons may thus be drawn away and washed for tar, ammonia, etc., or brought back through the incandescent fuel, or through the outlets for carbonic oxide, and be converted by the heat into permanent gases. Of course, this conversion might be attained by conducting the heavy hydrocarbon vapours through a separate furnace. It is also proposed to arrange the upright air-supply nozzle in a column of brickwork, and to provide it with a cover or plug having openings for the distribution of the air-blast in any desired direction. The specification is accompanied by plans showing how the invention may be applied to the principal forms of producers in common use.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Pseudo-eumenol. K. Auwers. Ber. **17**, 2976.

The compounds described were obtained from pseudo-cumenol $C_6H_2(CH_3)_3.OH$ [1, 3, 4, 6] (*Ber.* 11, 29 and 17, 2676). Trimethylortho-oxybenzaldehyde,

$C_6H(CH_3)_3.CHO.OH$ [1, 3, 4; 5; 6]

was prepared, according to Reimer-Tiemann's method (*Ber.* 9, 824), by dissolving equal weights of ψ-cumenol and caustic soda in 50 parts of water, and adding gradually one part of chloroform, the mixture being heated on the water bath for three or four hours. The yellow liquid was acidified with hydrochloric acid and hydrolysed. After digesting the distillate for four hours with dilute alkali, a clear brown substance remained, while the filtrate when acidified deposited a yellow precipitate, consisting of a mixture of unaltered phenol and oxyaldehyde. The substances were separated by fractional crystallisation from alcohol, in which the oxyaldehyde is but slightly soluble. The pure substance crystallised in yellow needles, melting at 105-106.° It is insoluble in water, but dissolves easily in ether, chloroform, and glacial acetic acid. It forms a mirror with ammoniacal silver solution. The chloroform reaction gives only ortho and para compounds, and as the latter is impossible in this case, the constitution is proved. The oxyaldehyde exhibits all the properties of an ortho compound. The brown residue insoluble in dilute alkali crystallised readily from alcohol in long lustrous prisms and tables, melting at 98-99°. It is insoluble in cold water, moderately soluble in alcohol ether, chloroform, and acetic acid. Its composition was found to be $C_{10}H_{12}Cl_2O$, but its constitution was not ascertained. The formula $C_6H(CH_3)_3CHCl_2.OH$ appears unlikely, on account of the great stability of the substance with

alkalis. It is more probably a dichloromethyl ether of pseudo-cumenol, $C_6H_2(CH_3)_3.OCHCl_2$.

Metamononitropseudo-cumenol nitric ether,

$$C_6H(CH_3)_3NO_2.ONO_2 \ [1, 3, 4; 2; 6].$$

One part of ψ-cumenol was dissolved in 6 parts of cold fuming nitric acid, and the solution was poured into water. The yellow solid was pressed between filter paper and washed with cold alcohol. It crystallised from ether in lustrous rhombic tables or prisms, melting at 84° with decomposition. The substance was analysed. It is insoluble in water, slightly soluble in cold alcohol, ether, and acetic acid, but readily soluble in chloroform. It forms a red solution, with caustic alkalis, but undergoes decomposition, for on addition of hydrochloric acid a yellow body is precipitated, and nitrous fumes are evolved. The precipitate, however, still contains nitrogen; hence the two nitro groups are differently combined, and probably the hydrogen in the hydroxyl group is replaced by NO_2.

Meta-amidopseudo-cumenol,

$$C_6H(CH_3)_3NH_2.OH. \ [1, 3, 4; 2; 6].$$

A solution of the nitric ether in glacial acetic acid was reduced with hydrochloric acid and tin, when hydrogen and nitrous fumes were evolved. The tin was precipitated, and the filtrate evaporated, when the hydrochloride of the base separated in yellow-brown crystals. The base was precipitated from a solution of the hydrochloride as a white substance which turned brown in the air. It was found to be identical with Liebermann's oxycumidine prepared from phenylazo-cumenol (*Ber.* 17, 886). The substance does not form an anhydro-compound, hence the hydroxyl and amido groups are probably in the meta position.

Dinitropseudo-cumenol,

$$C_6(CH_3)_3(NO_2)_2OH \ [1, 3, 4; 2, 5; 6].$$

When 5 to 10cc. of concentrated alcoholic ammonia are added to a gram of the nitric ether, the latter is dissolved with evolution of heat, but fine needles are soon deposited. The ammonia was neutralised with hydrochloric acid and the substance crystallised from alcohol. It formed yellow crystals, melting at 110°. It is insoluble in cold water, but dissolves easily in alcohol, ether, chloroform, and acetic acid. It deflagrates when heated above the melting point. It dissolves in aqueous alkalis without change.

Dipseudo-cumenol or *hexamethyldiphenol*,

$$OH.(CH_3)_3HC_6\text{–}C_6H(CH_3)_3.OH.$$

In the preparation of pseudo cumenol a black-brown resin was formed, which was not volatilised by the steam. By treating the resin with alcohol, white crystals were obtained, which, when recrystallised from acetic acid, melted at 172°. The same substance was obtained by Hofmann from the resin formed in the preparation of pseudo-cumenol ether from pseudo-cumidine (Ber. 17, 1918). The product dissolves in alkalis without decomposition. The yield was only 2½ per cent. of the ψ-pseudo-cumidine employed, but Hofmann has obtained a similar compound by treating the tetramethylphenol with potassium bichromate and acetic acid. In the same way the author obtained dipseudo-cumenol by the oxidation of ψ-cumenol.

Dipseudo-cumenol methylether. The two substances were further identified by introducing methyl groups by means of caustic potash and methyl iodide, but the analyses left it uncertain whether the mono or dimethyl compound was formed.—S. Y.

Separation of so-called α-Lutidine. A. Ladenburg and C. F. Roth. Ber. **18**, 913.

THE authors recently described the separation of a lutidine from commercial picoline; they now announce the isolation of a second lutidine from animal oil, boiling from 160° to 180°, obtained from Kahlbaum. The oil was fractionated into four portions, the lowest boiling between 158° and 160°. From this fraction two lutidines were separated, the first by means of mercuric chloride, the second with ammonium molybdate. The first of these is described. By the addition of mercuric chloride to a strongly acid solution of the mixed hydrochlorides, a flocculent colourless precipitate was obtained. The substance melted at 125°, dissolved in hot water, and crystallised on cooling in white needles, melting at 130°. The formula was found to be $C_7H_9NHCl,2HgCl_2,\frac{1}{2}H_2O$. The base, liberated by caustic potash, boiled at 157° It is more soluble in cold than in hot water, and dissolves in all proportions in alcohol and ether. The odour resembles that of fresh-cut cucumber. The formula is C_7H_9N. It is not coloured red either by concentrated hydrochloric acid or by benzoyl chloride. The crystalline platinum and gold salts were prepared and analysed. The oxidation of the lutidine was effected by boiling it with a 3 per cent. solution of potassium permanganate. When the colour disappeared the liquid was allowed to cool, filtered, neutralised with sulphuric acid and evaporated. The potassium sulphate was precipitated by alcohol, and the latter distilled off. The silver salt was prepared, washed with cold water, and decomposed by sulphuretted hydrogen. On evaporation of the filtrate the acid was obtained in lustrous scales, melting at about 235° The formula was found to be $C_7H_5NO_4.H_2O$. It is, therefore, a pyridine dicarboxylic acid, and it is probably the α-γ compound, identical with Böttinger's pyridine dicarboxylic acid. Small quantities of impurities alter the physical properties of the acid very greatly, and a second preparation agreed very closely before careful purification with Weidel and Herzig's lutidinic acid, which the authors believe to be also identical with theirs. The calcium, copper, lead, barium and silver salts were prepared. On heating the acid slowly to 245° in a current of hydrogen, carbon dioxide and γ-pyridine carboxylic acid were formed. The acid was obtained from the precipitated copper salt. When crystallised from hot water, it melted at 296°, but after sublimation at 303°. It was undoubtedly isonicotinic acid, and hence the lutidine and lutidinic acids must be α-γ compounds. Five pyridine dicarboxylic acids are now known with certainty:—1, quinolinic acid (α-β); 2, cinchomeronic acid (β-γ); 3, α-lutidinic acid (α-γ); 4, β-lutidinic acid (α-α′); 5, isocinchomeronic acid (β-β′ or α-β′). The reduction of the α-γ lutidine was effected by treating a hot concentrated alcoholic solution with sodium. No smell of ammonia was observed. Water was added, and the base distilled over with steam. The hydrochloride was prepared and purified, and reconverted into the base. The α-γ hydrolutidine boils at 140° to 142°, and is easily soluble in water, alcohol and ether. Its odour resembles that of the piperidine bases. Its formula was found to be $C_7H_{15}N$. The secondary nature of the base is shown by its compound with carbon-bisulphide and benzoyl chloride. The hydro-chloride melts at 235°, and has the composition $C_7H_{15}N.HCl$. The hydrobromide and picrate were prepared, also the gold and platinum double chlorides. The authors have isolated naphthalene from the animal oil boiling above 170°.—S. Y.

Retene. E. Bamberger and S. C. Hooker. Ber. **18**, 1024.

CERTAIN facts observed by Ekstrand—viz., the reduction of retistene-quinone to retene by means of zinc dust, and the production of retene from retistene-ketone, have induced the authors to repeat their analysis of the quinone, to which they had previously assigned the formula $C_{16}H_{14}O_2$. The results of the later analysis shows this substance to have the composition $C_{18}H_{16}O_2$, the discrepancy being attributed to its difficultly combustible nature. This compound is, therefore, the quinone of retene, and not of the hypothetical hydrocarbon retistene. It yields, on oxidation with permanganate solution, oxyisopropyldiphenyleneketonecarboxylic acid, and diphenyleneketonecarboxylic acid.—J. B. C.

On Nononaphthene. M. Konowalow. Journ. d. Russ. Phys. Chem. Gesellsch. 1884 [2].

THIS hydrocarbon C_9H_{18} has been separated from the kerosine of the rock oil of Balachany, as well as from Beibatzky's rock oil. It boils at 135° to 136°, and has the specific gravity 0·7808 at 0° and 0·7652 at 20°. It is

acted on energetically by bromine, but only substitution products are formed. The presence of aromatic hydrocarbons could always be detected by Gustavson's reaction, but the amount never exceeded 0·5 per cent. Nononaphthene yields two chlorides of the composition $C_9H_{17}Cl$, the one boiling at 185° to 188°, the other at 182° to 184°. The latter compound, when heated in a tube with silver acetate, yielded an ether which boiled at 200° to 203°, and possessed a pleasant fruity smell. By heating the higher boiling chloride with plumbic hydrate, an alcohol was formed which yielded a ketone on oxidation, and, when heated in a tube with calcium iodide, it gave an iodide $C_9H_{17}I$, which distilled between 100° and 110°, at a pressure of 24mm., and was converted into an alcohol when treated with silver oxide. The chlorides in all the reactions described, yielded as a bye-product a nononaphthylene C_9H_{16}, hydrochloric acid being liberated. This hydrocarbon boiled at 135° to 137°, and its specific gravity was found to be 0·8068 at 0°. By oxidation with chromic acid, nononaphthylene yielded ethylmethylketone, and a number of acids containing 2, 3 and 4 atoms of carbon. Nononaphthylene is reconverted into nononaphthene by heating it with hydriodic acid in closed tubes to 150° to 200°, and finally to 250°.—S. Y.

On a Homologue of Quinoline. C. Beyer. Journ. f. Pr. Chem. 31, 47.

ANILINE was heated in closed tubes with acetone, nitrobenzene and hydrochloric acid, when an oily base, of the composition $C_{11}H_{11}N$, volatile with steam, was obtained. The hydrochloride and sulphate are easily soluble. The platinum double salt forms flesh-coloured needles, melting at 227°. The picrate crystallises from acetone in lustrous yellow scales, melting at 170°; the chromate separates from water in yellow-red needles, which are more freely soluble than the chromates of other quinoline derivatives.—S. Y.

IV.—COLOURING MATTERS AND DYES.

Compounds of Benzaldehyde with Aniline-hydrochloride and Stannic Chloride. A. Elbers. Annalen, **227**, 357.

ON adding benzaldehyde to a solution of aniline in strong hydrochloric acid, a precipitate is formed, which, on warming, redissolves, and crystallises out in the form of fine yellow needles. The compound consists of equal molecules of benzaldehyde and aniline hydrochloride, into which it is resolved by water, and is only stable in presence of strong hydrochloric acid. If stannic chloride is also present, a compound is formed, containing benzaldehyde, aniline and $SnCl_4$, in the molecular proportion 3 : 2 : 1.—A. G. G.

A New Synthesis of Pararosaniline. J. Zimmermann and Albert Müller. Ber. **17**, 2936.

A MIXTURE of 20grm. paranitrobenzylidine bromide, prepared as described by Wachendorff by the action of bromine on paranitrotoluene (Ann. 185, 267), with 25grms. aniline, was heated slowly in an oil bath. The bromide first of all dissolved, then a separation of lustrous scales occurred, probably of the anilide of the para-nitrobenzylidine compound; at 145° a sudden and energetic reaction took place, the thermometer rising to 200°. The excess of aniline was then distilled over with steam, and the residue boiled repeatedly with water. The red aqueous solution imparted to wool and silk a beautiful carmine colour. The solution was precipitated by ammonia or caustic soda, and the colourless precipitate reduced with zinc dust and hydrochloric acid. It was identified as paraleucaniline. The residue, insoluble in water, dissolved easily in alcohol, and gave a bluer colour than the pararosaniline. The reaction differs from that described in a patent by Meister, Lucius and Brüning, inasmuch as a solvent is not employed. The authors attempted to prepare paranitrobenzylidine chloride by the action of chlorine at 130° to 160° on paranitrotoluene, but found that paranitrobenzoic acid was chiefly formed. The action of fuming nitric acid on benzyldichloride also gave negative results.—S. Y.

On Crystallised Methyl-violet. A. W. Hofmann. Ber. **18**, 767.

THE author has examined some samples of a new methyl-violet, which has recently been introduced by the Actiengesellschaft für Anilin Fabrikation, of Berlin. This colouring matter is obtained by the action of chlorinated methyl-formiate upon dimethylaniline in the presence of aluminium chloride. (See this Journal, iv. [4], 279). In its tendency to crystallise well, it surpasses all aniline colours known. The crystals are opaque and show a peculiar greenish-brown metallic lustre. They are readily soluble in water and alcohol, the former solvent being the more suitable one for the purpose of recrystallisation. Many of the crystals were as much as 3 to 4 millimetres in diameter, and so well developed that pretty accurate measurements of the angles could be taken. The crystalline forms were those of the hexagonal prism and pyramid. The analysis of the recrystallised substance gave numbers showing its composition to be that of the hydrochloride of a hexamethylated rosaniline, $C_{19}H_{12}(CH_3)_6N_3Cl$. The composition of the platinum chloride double salt (obtained as a brick-red precipitate by adding platinum chloride to a solution of the colouring matter in concentrated hydrochloric acid) was found to agree with the formula $[C_{19}H_{12}(CH_3)_6N_3Cl]_2(PtCl_4)_3$. The leuco compound was prepared by heating the violet with an aqueous solution of ammonium sulphide in a closed tube to 120°, and recrystallising the product obtained from alcohol. It melts at 173°, this being the same melting point as that found by O. Fischer for the base prepared from ordinary methyl-violet, considered by him to be a salt of hexamethylpararosaniline. The mode of preparation and the properties of the crystallised violet bear a great resemblance to those of a likewise well-crystallised violet-colouring matter, which is being manufactured by the Badische Anilin- und Soda-Fabrik. Their patented method (this Journal, iv. [4], 279) is founded on Michler's researches on the action of carbonyl-chloride upon dimethylaniline. The identity of the two colouring matters is therefore highly probable, and was proved by the fact that the leuco base of the latter also melts at 173°. The reactions which take place in the formation of methyl-violet from dimethylaniline and carbonyl-chloride are expressed by the following equations:—

$$\text{(I.)}\ C_6H_5N(CH_3)_2 + COCl_2 = C_6H_4N(CH_3)_2COCl + HCl;$$

$$\text{(II.)}\ C_6H_4N(CH_3)_2COCl + C_6H_5N(CH_3)_2 = \begin{matrix} C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \end{matrix}\!\!>CO + HCl;$$

$$\text{(III.)}\ \begin{matrix} C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \end{matrix}\!\!>CO + COCl_2 = \begin{matrix} C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \end{matrix}\!\!>CCl_2 + CO_2$$

$$\text{(IV.)}\ \begin{matrix} C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \end{matrix}\!\!>CCl_2 + C_6H_5N(CH_3)_2 = \left.\begin{matrix} C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \\ C_6H_4N(CH_3)_2 \end{matrix}\right\rangle CCl + HCl$$

The observation of O. Fischer and G. Körner, that by the action of ortho-formic ether upon dimethylaniline in the presence of zinc chloride a leuco base is formed possessing the same properties and the same melting point as that mentioned, is a further proof for the correctness of the supposition that the colouring matter is a hexamethylpararosaniline. The methyl-violet obtained by Wichelhaus's method—treatment of dimethylaniline with chloranil—seems also to be a hexamethylpararosaniline, but the author thinks that further experiments are necessary to remove all doubts as to its composition. —F. M.

On the Action of Diazo-compounds on β-Naphthylamine. T. A. Lawson. Ber. **18**, 796.

THE researches of Zincke and Bindewald on the hydrazine derivatives of α- and β-naphthoquinones have shown that while the derivative of α-naphthoquinone is identical with the phenyl azo-α-naphthol obtained by the action of diazo-benzene chloride on α-naphthol, the corresponding derivative of β-naphthol is not identical with the

hydrazide from β-naphthoquinone, but is probably an isomeric hydrazine compound.

It appeared likely that a similar difference would be observed in the action of α- and β-naphthylamine on diazo-compounds. The action of diazo-compounds on α-naphthylamine has been frequently studied, and there is no doubt that true azo-compounds are formed. Griess and Meldola have also investigated the action of certain diazo-compounds on β-naphthylamine, but the nature of the products is not so certain. The researches of the author point to the fact that diazo-amido compounds are formed by the action of diazo-compounds on β-naphthylamine. By boiling the products with acids nitrogen is evolved, and β-naphthylamine reproduced. This is the case with the compounds prepared by Griess and Meldola. These bodies are characterised by their yielding acetyl- and benzoyl-compounds, and on reduction they behave like amido-azo-compounds, yielding a naphthylenediamine.

Phenyldiazo-β-naphthylamine $C_{10}H_7NHN=N-C_6H_5$ was prepared by dissolving 20grm. crystallised diazobenzene sulphate in 50cc. water and 50cc. alcohol, and adding an alcoholic solution of 14grm. β-naphthylamine. The red precipitate was recrystallised from alcohol. It melted at 102° to 104°. It was not decomposed by boiling with alcoholic potash, or by solution in strong sulphuric acid. This solution has a fine blue colour; hydrochloric and acetic acids also give coloured solutions. When boiled with twenty per cent. sulphuric acid the substance is dissolved with evolution of nitrogen and formation of phenol and β-naphthylamine. The acetyl-compound $C_{10}H_7N(C_2H_3O)N=NC_6H_5$ melts at 152° to 153°, and is very stable. The benzoyl-compound melts at 162° to 163°. These bodies were analysed.

The reduction of phenyldiazo-β-naphthylamine was effected by boiling its alcoholic solution with stannous chloride until the colour disappeared, or by treating it with zinc dust and acetic acid. The base was set free from the hydrochloride or sulphate by addition of sodium carbonate. It melts at 94°, and is easily oxidised. The base has been described by Griess. It is probably an α-β-compound. The hydrochloride and sulphate were prepared and analysed; the composition of these salts is $C_{10}H_6(NH_2)_2.2HCl$, and $C_{10}H_6(NH_2)_2,H_2SO_4$. The picrate was also prepared. The acetyl-compound melts at 234°, and has the composition $C_{10}H_6(NHC_2H_3O)_2$. The benzoyl-compound melts above 280°, and its formula is

$$NH_2.C_{10}H_6.NH.C_7H_5O.$$

—S. Y.

On Nitroso-derivatives of Aromatic Diamines. O. N. Witt. Ber. **18**, 877.

THIS paper contains some preliminary communications on the nitroso-amines corresponding to the nitroso-resorcins. By adding to a cold solution of tetramethylmetaphenylenediamine in an excess of dilute hydrochloric acid, a moderately dilute solution of sodium nitrite, a deep reddish-brown precipitate is formed, which by recrystallisation from slightly acidulated hot water is obtained in a state of purity. It then forms deep garnet-red, almost black, lustrous needles, which in pure water dissolve with a claret-red colour. The analysis showed this body to be the monohydrochlorate of a mononitrosotetramethylmetaphenylenediamine,

$$C_6H_3\begin{cases}N(CH_3)_2\\N(CH_3)_2.HCl\\NO.\end{cases}$$

The free nitroso-base is prepared by adding sodium carbonate or hydrate to an aqueous solution of this body, and extracting the now orange-yellow solution with ether. On the evaporation of the ether the base is left as a deep-brown, oily liquid, which gradually assumes a crystalline form. The aqueous solution of the nitrate of this base gradually decomposes, a reddish-yellow precipitate, probably consisting of nitrotetramethylphenylenediamine, being formed. Reducing agents quickly decolourise the solutions. The new nitroso-compound readily combines with amines and phenols to form colouring matters of different shades. Those derived from naphthylamine, naphthol, and resorcin exhibit a strong fluorescence. The red salt described was likewise obtained by acting with two molecules of sodium nitrite upon one molecule of the diamine, no dinitroso-compound being formed in this case. The nitroso-group diminishes the basic properties of the diamine; the latter forms stable salts with two molecules of hydrochloric acid, whereas the nitroso-compound combines with only one molecule. Tetramethyltolylenediamine behaves in a similar manner to the phenylene-compound, but the nitroso-compound could not be separated in solid form.—F. M.

On Indigodicarboxylic Acid. Wilhelm Löw. Ber. **18**, 947.

THE material from which the indigo-dicarboxylic acid was prepared was terephthalaldehyde, which was obtained from paraxylylene bromide (prepared by brominating paraxylene) by boiling it with water. The author describes the following derivatives of terephthalaldehyde:—

(1.) *Terephthylic Acid** $C_6H_4\begin{matrix}COH & (1)\\COOH & (4)\end{matrix}$, obtained by oxidising the aldehyde with the calculated quantity of potassium bichromate and sulphuric acid. It crystallises in needles, melting at 255°. The ether was prepared by passing hydrochloric acid gas into the alcoholic solution.

(2.) *Nitroterephthylic Acid*, $C_6H_3-\begin{matrix}COH & (1)\\NO_2 & (2).\\COOH & (4)\end{matrix}$ A solution of terephthylic acid in concentrated sulphuric acid was treated with the calculated quantity of potassium nitrate dissolved in sulphuric acid. The nitro-acid forms large needle-shaped prisms, melting at 160°. It gives the indigo reaction with acetone. The ethyl ether is an oil.

(3.) *Paracarboxylcinnamic Acid*,

$C_6H_4\begin{matrix}CH.CH.COOH & (1)\\COOH & (4)\end{matrix}$. This was best obtained by heating terephthylic ether with sodium acetate and acetic anhydride, and boiling the product with dilute caustic soda. The acid cannot be fused, and is almost insoluble in most substances. It may be crystallised from hot glacial acetic acid.

(4.) *Paradibromocarboxylcinnamic Acid*,

$C_6H_4\begin{matrix}CHBr-CHBr-COOH\\COOH\end{matrix}$, was prepared by the direct action of bromine, at 100°, on the last compound. It was crystallised from methyl-alcohol.

(5.) *Nitrocarboxylcinnamic Acid*,

$C_6H_3\begin{matrix}CH.CH.COOH & (1)\\NO_2 & (2)\\COOH & (4)\end{matrix}$, was formed by treating the carboxylcinnamic acid with a mixture of nitric and sulphuric acids. It crystallises from hot water in needles, which melt at 287°, but decompose partially.

(6.) *Dibromonitrocarboxylcinnamic Acid*,

$C_6H_3\begin{matrix}CHBr-CHBr-COOH & (1)\\NO_2 & (2)\\COOH & (4)\end{matrix}$, obtained by the direct action of bromine, at 100°, on the nitro-acid, yields, when treated with concentrated caustic soda, the corresponding propiolic acid, $C_6H_3\begin{matrix}C\vdots C.COOH\\NO_2\\COOH\end{matrix}$, nitrophenylpropiolcarboxylic acid.

Indigodicarboxylic Acid.

(1.) Nitroterephthylic acid was treated with acetone and caustic soda, and the very dilute solution was heated for two hours to 50°. By the addition of dilute sulphuric

* *Note by Abstractor.*—I have ventured to call this acid "terephthylic acid," because it stands between terephthalaldehyde and terephthalic acid, just as glyoxylic acid occupies a position between glyoxal and oxalic acid.—S. Y.

acid to the dark green solution, a deep blue precipitate of indigodicarboxylic acid was obtained. After washing and drying, it exhibited a coppery lustre.

(2.) A very dilute solution of nitrophenylpropiolcarboxylic acid in sodium carbonate was heated with grape sugar and caustic soda until permanently alkaline. The indigo-compound was separated from the green solution as before. Indigodicarboxylic acid is insoluble in ether, chloroform, and alcohol, but forms a deep blue solution with sulphuric acid, from which water precipitates the acid unaltered. The spectrum of the solution in alkalis resembles that of indigo, but the bands are nearer the red. The metallic salts are generally green or blue, but the silver salt has a sepia-brown colour. The barium salt has the composition $C_{18}H_8N_2O_6Ba$, but the silver salt contains four atoms of silver, so that the hydrogen atoms of the imido groups must also be replaced.

The ethyl ether was prepared from the nitroterephthylic ether by the first method described above. It melts at a high temperature, and sublimes in prismatic crystals. It dissolves with a deep blue colour in sulphuric acid, and is reprecipitated by water, but undergoes partial saponification.—S. Y.

A New Group of Colouring Matters. O. N. Witt. Ber. **18**, 1119.

These bodies are obtained by heating the amidoazo derivatives of *p*-toluidine (m.p. 118·5) with the hydrochlorides of primary amines. With α-naphthylamine, a product is obtained which bears no analogy to the indulines. The following is the method of preparation: 13grm. amidoazo-toluene are mixed with 18grm. α-naphthylamine hydrochloride, and as solvent 50grm. to 60grm. free naphthylamine are added. The mixture is warmed on the water-bath until the green colour changes to an orange-red. The calculated quantity of NaOH required to saturate the HCl present is added, and 3 to 4 volumes of alcohol. The new compound separates out on cooling. Crystallised from aniline, it forms yellow needles, having the formula $C_{24}H_{18}N_4$. The hydrochloride and sulphate of the base dissolve in water with a scarlet colour, and dye cloth the same shade. On soaping, the colour changes to yellow. Fuming sulphuric acid converts it into a sulphonated compound. The sulpho salt colours silk, in acetic acid solution, a fine orange. From the analysis, it appears probable that the substance is a saffranine derivative of *o*-toluylenediamine. The above reaction is not limited to amidoazotoluene, but is common to all amidoazo bodies which contain the amido group in the ortho position with respect to the nitrogen atom. The azo derivatives of β-naphthylamine, as also the chyrsoidines, give the same reaction. This reaction may be therefore used in determining the relative positions of the substituted groups in amidoazo compounds. —J. B. C.

β-Sulphophthalic Acid. C. Graebe. Ber. **18**, 1126.

Binitronaphthol-sulphonic acid (the free acid of the potash salt, which forms the naphthol yellow S of commerce), when heated on the water-bath with nitric acid of sp. gr. 1·3, yields β-sulphophthalic acid. It is obtained as a syrup, which crystallises with difficulty, and is easily soluble in water and alcohol, but not in ether. The crystallised substance contains 1mol. of water. Sulphophthalic acid gives a corresponding fluoresceine derivative, which has no technical value as a colouring matter. It may be converted into β-oxyphthalic acid and the corresponding eosines.—J. B. C.

Intermediate Products of Reduction of the Nitroazo Compounds. J. V. Janovsky and L. Erb. Ber. **18**, 1133.

The paper is to a certain extent a repetition of the researches of Gerhardt, Laurent and Petriew on the nitro derivatives of azobenzene. The authors have prepared the mono and the dinitro derivatives, the former yielding, on reduction, aniline and *p*-phenylenediamine, and the latter *p*-phenylenediamine, thus proving that the nitro groups occupy in reference to the azo group the position 1·4. In the preparation of these nitro compounds, in addition to the above crystalline products, a considerable quantity of a red oil is formed. This, on reduction, yields *m*-phenylenediamine, and the oil is therefore a *m*-dinitroazobenzene. By further nitrating the dinitro compound, two trinitroazobenzenes are formed. By reducing mononitroazobenzene with $(NH_4)_2S$, azoamidobenzene is obtained. From the dinitro compound, hydrazodinitrobenzene and hydrazoamidobenzene are produced. On the other hand, if an alkaline reducing agent, such as an aqueous solution of $(NH_4)_2S$, or alkaline solutions of $ZnCl_2$, $SnCl_2$ or grape sugar, all the nitroazobenzenes yield intermediate products, which the authors have named "nitrolic acids" of azobenzene. The constitution of these bodies is explained by the following formulæ:—

Nitrolic acid from mononitroazobenzene .... $\left\{\begin{array}{l} C_6H_5-N=N-C_6H_4N.OH \\ \qquad\qquad\qquad\qquad | \\ C_6H_5-N=N-C_6H_4N.OH \end{array}\right.$

Nitronitrolic acid from dinitroazobenzene $\left\{\begin{array}{l} NO_2C_6H_4-N=N-C_6H_4.N.OH \\ \qquad\qquad\qquad\qquad\qquad | \\ NO_2C_6H_4-N=N-C_6H_4.N.OH \end{array}\right.$

—J. B. C.

Brasilin. K. Buchka and A. Erck. Ber. **18**, 1138.

Brasilin gives, on heating with acetic anhydride to 130°, a tetracetyl and a triacetyl derivative. By the action of bromine on the former compound, a mono-, a tri- and a tetrabromobrasilin were obtained. By the oxidation of brasilin with nitric acid, in an ethereal solution, brasilein, $C_{16}H_{10}O_5$, is formed.—J. B. C.

Azylines. E. Noelting. Ber. **18**, 1143.

The compounds obtained by Lippmann and Fleissner, by the action of NO gas on tertiary amines, were regarded as the azo derivatives of these bases. This view has been confirmed by the author, who, by the action of dimethylaniline upon the chloride of the diazo derivative of *p*-amido dimethylaniline, obtained a substance having the properties of Lippmann's tetramethylazyline, according to the equation

$$N(CH_3)_2.C_6H_4.N:N.ClC_6H_5N(CH_3)_2$$
$$=N(CH_3)_2.C_6H_4.N:N.C_6H_4.N(CH_3)_2+HCl.$$

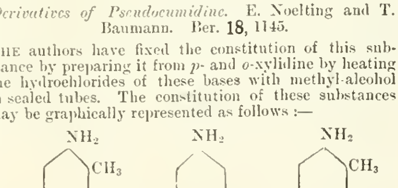
The same compound has been further obtained by the action of methyl-iodide on the base

$$NH_2.C_6H_4.N:N.C_6H_4.N(CH_3)_2,$$

first prepared by Meldola. The azylines are isomeric with the chrysoidines, and are similarly prepared. The primary substance of this class is the symmetrical diamidoazobenzene, which may be termed "azyline." Like the chrysoidines, these bodies have colouring properties, but owing to the costly process of preparation will probably have no technical value.—J. B. C.

Derivatives of Pseudocumidine. E. Noelting and T. Baumann. Ber. **18**, 1145.

The authors have fixed the constitution of this substance by preparing it from *p*- and *o*-xylidine by heating the hydrochlorides of these bases with methyl-alcohol in sealed tubes. The constitution of these substances may be graphically represented as follows:—



p-xylidine. *o*-xylidine. pseudocumidine.

Diazoamidocumene is prepared in the usual way by the action of $NaNO_2$ upon the hydrochloride of cumidine. The diazo compound is then brought into an acetic acid solution of cumidine, and sodium acetate added. Diazoamidocumene separates out. By heating this compound with cumidine and cumidine hydro-

chloride to 60° to 80° it is converted into amidoazocumene, which crystallises from alcohol in yellow plates. By reduction with $SnCl_2$ and HCl, amidoazocumene splits up into cumidine and cumylenediamine, which may be separated by fractional distillation with steam.

Amidotetramethylbenzene.—If cumidine hydrochloride be heated with one molecule of methylalcohol to 200° for ten hours, and then to 300° for a further ten hours, a liquid base is obtained, boiling at 250° C., which crystallises in a freezing mixture. Mesidine, under similar conditions, gives the same compound. It must therefore be a derivative of isodurene, and has received the name of isoduridine.—J. B. C.

Quinones from Para-methylated Amines. E. Noelting and T. Baumann. Ber. **18**, 1150.

THE following amines were oxidised with chromic acid :—*p*-toluidine, α-*m*-xylidine and *o*-xylidine, the former yielding quinone, the two latter toluquinone in very small quantity. Mesidine gives a satisfactory yield of *m*-xyloquinone (m.p. 72° to 73°) and pseudocumidine, *p*-xyloquinone (m.p. 123°); isoduridine gives on oxidation an oil, which may be purified by first reducing to the crystalline cumohydroquinone, which, on oxidation, forms the pure quinone (m.p. 11°).—J. B. C.

The Influence of Light on the Course of the Chemical Reaction of Halogens on Aromatic Compounds. J. Schramm. Ber. **18**, 1272.

BROMINE when present in excess acts on ethylbenzene in the dark, forming ortho- and paraethylmonobromobenzene. The action of bromine on propylbenzene in the dark is similar, two isomeric bromine derivatives being formed. In the direct light of the sun, however, bromine enters the propyl-radical, forming monobromopropylbenzene in the first instance, and further on, dibromopropylbenzene—*e.g.*, ethylphenyldibromoketole $C_6H_5-CBr_2-CH_2-CH_3$. If 1mol. bromine acts in the dark on monobromopropylbenzene, produced under the influence of sun-light, bromoallylbenzene $C_6H_5-CHBr-CHBr-CH_3$ is formed identical with that made directly from bromine and propylbenzene. Butylbenzene acts exactly like propylbenzene. Paraxylene and bromine form in the dark parabromoxylene, whereas in the presence of light the methyl-radical is attacked. The two isomeric compounds, meta- and orthoxylene, behave like the para compound.—S. H.

Laboratory Notes. E. Noelting. Bull. Soc. Ind. Mulhouse, 1885, 144.

(*a*) *New Azo Derivatives* (Sealed Note, June 1, 1881). —Thioaniline $(C_6H_4.NH_2)_2S$ is converted by nitrous acid into a diazo derivative, described some years since by Krafft. This compound treated, on the other hand, with phenols or their sulphonated derivatives, in alkaline solution, yields azo derivatives constituting a class of colouring matters. When aniline is treated with β-naphtholdisulphonic acid, an orange-coloured body is produced; thioaniline under the same treatment yields a ponceau, equal in depth of blue to the ponceaus R R R of Meister, Lucius and Brüning. Diamidosulphobenzide under these conditions yields an orange; benzidine, on the other hand, a brownish violet, analogous to the Bordeaux of the same makers.

The constitution of these bodies is as follows :—

$C_6H_5.N=N.-\beta C_{10}H_4.OH(SO_3H)_2$ orange (M., L. & B.)

$SO_2[C_6H_4N:N-\beta.C_{10}H_4OH(SO_3H)_2]_2$ orange (Noelting)

$S[C_6H_4N:N\beta.C_{10}H_4OH(SO_3H)_2]_2$ ponceau (Noelting)

$$\left.\begin{array}{l} C_6H_4.N:N-\beta.C_{10}H_4.OH(SO_3H)_2 \\ C_6H_4N:N-\beta.C_{10}H_4OH(SO_3H)_2 \end{array}\right\} \begin{array}{c}\text{violet (Bordeaux)} \\ \text{(Noelting)}\end{array}$$

The bisulphonated derivative of benzidine gives with β-naphthol a beautiful ponceau. The chief interest of these compounds is in showing the influence exerted by the various S-groups in modifying colour.

(*b*) *Violet Colouring Matter from Paramidophenol* (Sealed Note, June 1, 1881).—Some time since Lauth obtained a series of violet colouring matters by treating the paradiamines of benzene and toluene with hydrogen sulphide and ferric chloride. Corresponding blue derivatives, in which two atoms of H are replaced by alkyl-radicals, have also been obtained. The author finds that paramidophenol is converted by the same treatment into a violet colouring matter. The result is probably typical.

(*c*) *Isobutyl Anilines* (Sealed Note, June 1, 1881).—By the action of isobutyl bromide upon aniline at 100°, or of isobutyl alcohol upon the hydrochlorate at 200°, mono- or di-isobutyl aniline is formed according to the proportions of the reagent employed. The mono derivative boils at 230-235°. Its acetyl derivative $C_6H_5.N(C_4H_9).C_2H_3O$ is an uncrystallisable oil, boiling at 260-265°. The latter yields a crystalline nitro derivative, which is converted by the action of tin and hydrochloric acid into monobutylparaphenylenediamine—*i.e.*, with elimination of the acetyl group. This base, treated with hydrogen sulphide, and afterwards with ferric chloride, is converted into a blue colouring matter, soluble in water.—C. F. C.

Pyridine Dicarbonic Acid. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 147.

THIS acid, which is formed by the oxidation of quinoline with potassium permanganate, having its COOH groups in the ortho position, may be regarded as phthalic acid, in which an N atom takes the place of one of the CH groups of the benzene ring. In confirmation of this view the authors have demonstrated the following points of analogy in the reaction of the two acids. They both combine with phenols; heated with phenol and sulphuric acid at 120°, pyridine dicarbonic acid yields a product of condensation which dissolves in alkalis to a red solution. Heated with resorcin and a dehydrating agent at 200°, it yields a derivative resembling fluorescein, this yielding a bromo derivative, having the properties of eosine. In this reaction, however, a considerable proportion of the acid undergoes resolution into carbonic and nicotic acids.—C. F. C.

Preparation of Blues from Rosaniline. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 148.

ON heating metatoluidine (50pts.) with rosaniline (10pts.) and benzoic acid (5pts.), at 180°, a blue colouring matter is produced, as in the case of ortho- and paratoluidine. α-naphthylamine, under similar conditions, yields a violet, β-naphthylamine a blue (cf. Meldola, *Berl. Ber.* 16, 964). In the preparation of colouring matters of this class, on the large scale, aniline is used as the solvent, the excess being subsequently recovered. The authors have endeavoured to find a more economical substitute for the latter. In presence of phenol the desired result was not obtained; but by using naphthalene the development of a blue from aniline and rosaniline was found to follow the normal course. Experiments on the large scale, however, failed to establish any commercial advantage in the substitution of the hydrocarbon.—C. F. C.

Transformation of Primary Amines into Mononitrophenols. E. Noelting and E. Wild. Bull. Soc. Ind. Mulhouse, 1885, 153.

DINITRO derivatives of the phenols are formed, as was shown by Griess, when diazo compounds are boiled with nitric acid. By suitably varying the conditions from those which lead to this result, the authors have succeeded in preparing mononitro derivatives.

Mononitrophenol is obtained by operating in the following way:—93grm. aniline dissolved in 200grm. sulphuric acid, at 66° B., previously diluted with 2000cc. water, are diazotised at 0°, with 69grm. sodium nitrite. A quantity of nitric acid (1335 sp. gr.), containing 63grm. HNO_3, is then added, and the whole is boiled in connection with a reversed condenser, until the disengagement of nitrogen has ceased. The yield, in one experiment, was 20grm. ortho- and 15grm. paranitro-

phenol. The meta compound did not appear to be formed.

Nitrocresylol.—With 107grm. paratoluidine replacing the aniline in the above, a very considerable yield of the metanitroparacresylol is obtained. In one experiment it amounted to 75grm., $C_6H_3 . \overset{1}{(CH_3)} \overset{4}{OH} \overset{3}{NO_2}$ —melting at 33·5°. This was the sole product with exception of a small quantity of binitrocresylol and tarry derivatives. From orthotoluidine the nitro-ortho derivative (m.p. 69·5°) was obtained. The yield, however, was less than in the case of the former.

α-Naphthylamine was converted into the nitronaphthol $C_{10}H_6 \overset{(1)}{(OH)} \overset{(2)}{(NO_2)}$—m.p. 164—but the yield was small. Further investigations of the influence exerted by varying the conditions of these decompositions, will probably lead to their more complete realisation.—C. F. C.

Nitration under varying Conditions. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 163.

As a contribution to this subject, the authors give the results of nitrating various compounds in presence of sulphuric acid in large excess.

Acetanilide.—The para derivative is easily prepared by slowly adding 590 parts HNO_3 to 1000 parts acetanilide dissolved in 4000 parts H_2SO_4. The whole is cooled with a freezing mixture. The nitro compound is precipitated on pouring into water, and is obtained pure (m.p. 2070) by once recrystallising. The yield is 95 per cent. of the theoretical. The ortho and meta derivatives are formed only in small quantity; the proportion of the latter is increased by increasing that of the sulphuric acid.

Paratoluidine, nitrated in presence of ten parts of H_2SO_4, yields a mixture of the isomerides $\overset{(1)}{NH_2}\ \overset{(2)}{NO_2}\ \overset{(4)}{CH_3}$ (m.p. 114°) and 1, 3, 4 (m.p. 78°); by increasing the proportion of H_2SO_4 to fifteen to twenty parts, the latter only is formed. From 100grm. of the base, 100grm. of the nitrotoluidine were obtained.

Paraectotoluide, nitrated in presence of four parts H_2SO_4, yields, after saponification of the product, the isomeride $\overset{(1)}{NH_2}\ \overset{(2)}{NO_2}\ \overset{(4)}{CH_3}$ in presence of ten parts H_2SO_4, a product is obtained, yielding, on saponification, a mixture of the isomeric nitrotoluidines 1, 2, 4 (m.p. 114°), and 1, 3, 4 (m.p. 78°). The proportion of the latter is increased by increasing that of the sulphuric acid.

Orthotoluidine, nitrated in presence of ten parts H_2SO_4, yields a new isomeride, melting at 107°, and for which the authors have established the formula

$$C_6H_3 \begin{cases} NH_2 & (1) \\ CH_3 & (2) \\ NO_2 & (5) \end{cases}$$

Orthoacetotoluide yields a mixture of derivatives; but the nitration is, in this case, not so advantageous, and the authors, therefore, recommend the ordinary method.

Metaxylidine, nitrated in presence of ten parts H_2SO_4, yields the derivative

$$C_6H_2 \left\{ \begin{matrix} NH_2 & (1) \\ CH_3 & (2) \\ CH_3 & (4) \\ NO_2 & (5) \end{matrix} \right\} \text{(m.p. 123°).}$$

Metacetoxylide, nitrated as above, yields, by saponification, the same nitroxylidine (m.p. 123°).

Parabromaniline, nitrated in presence of ten parts H_2SO_4, yields a new nitrobromaniline

$$C_6H_3 \left\{ \begin{matrix} NH_2 & (1) \\ NO_2 & (3) \\ Br & (4) \end{matrix} \right\} \text{(m.p. 131·5°).}$$

The proof of its constitution is afforded by its yielding, on bromination, in glacial acetic acid, the same tribromonitraniline (m.p. 102·5°), as is obtained from metanitraniline.

Ethylacetanilide is easily nitrated in presence of five parts H_2SO_4. On saponifying the product (m.p. 118°), nitroethylaniline (m.p. 96°) is obtained. This compound is converted, by reduction with tin and hydrochloric acid, into a monoethylphenylenediamine. The reactions of this derivative are those characteristic of the paradiamines.

Dimethylaniline, in presence of a large excess of sulphuric acid, yields paranitrodimethylaniline exclusively. —C. F. C.

Nitro-orthotoluidine (m.p. 107°) and some of its Derivatives. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 193.

This compound, obtained as described in preceding abstract, crystallises in large prisms. It is soluble in alcohol, ether and acetone, but slightly in water. By diazotising and boiling the product it is converted into nitro-orthocresol

$$C_6H_3 \left\{ \begin{matrix} OH & (1) \\ CH_3 & (2) \\ NO_2 & (5) \end{matrix} \right\} \text{(m.p. 107°),}$$

the yield being nearly theoretical. This compound, treated with bromine in presence of water, is converted into the dibromo derivative (m.p. 91°). By reduction with tin and hydrochloric acid, it is converted into the amidocresylol (m.p. 160°) obtained by Wallach (*Berl. Ber.* 15, 2831) from metatoluylenediamine. By diazotising the nitratoluidine dissolves in nitric acid (2mol.); pouring the product into nitric acid, of sp. gr. 133, and boiling, a trinitro-orthocresol (m.p. 102) is formed. This compound forms molecular compounds with hydrocarbons; thus with naphthalene the compound

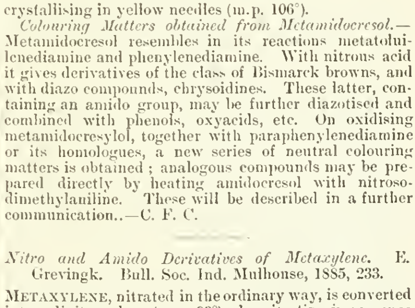
$$C_6H(NO_2)_3OH.CH_3.C_{10}H_8$$

crystallising in yellow needles (m.p. 106°).

Colouring Matters obtained from Metamidocresol.—Metamidocresol resembles in its reactions metatoluylenediamine and phenylenediamine. With nitrous acid it gives derivatives of the class of Bismarck browns, and with diazo compounds, chrysoidines. These latter, containing an amido group, may be further diazotised and combined with phenols, oxyacids, etc. On oxidising metamidocresylol, together with paraphenylenediamine or its homologues, a new series of neutral colouring matters is obtained; analogous compounds may be prepared directly by heating amidocresol with nitrosodimethylaniline. These will be described in a further communication..—C. F. C.

Nitro and Amido Derivatives of Metaxylene. E. Grevingk. Bull. Soc. Ind. Mulhouse, 1885, 233.

Metaxylene, nitrated in the ordinary way, is converted into a dinitroxylene (m.p. 93°); by nitrating in presence of sulphuric acid seven parts, a second isomeride (m.p. 82°) is formed simultaneously, in the proportion of about 25 per cent. of the mixed product. Both isomerides yield the same trinitroxylene (m.p. 176°) on further nitration. From these and other facts subsequently detailed, the authors deduce the following constitutional formulæ:—



Dinitroxylene (m p. 93°) Dinitroxylene (m.p. 82°) Trinitroxylene (m.p. 177°)

The isomeric dinitroxylenes are difficult of separation; but the corresponding nitroxylidines, into which they are converted by the action of ammonium sulphide, are sufficiently divergent in physical properties to be easily separable. That obtained from the second isomeride (m.p. 82°) is soluble in water and in petroleum spirit; it melts at 78°. That from the former (m.p. 93°) is almost insoluble in these menstrua; it melts at 123°. Further, the latter dinitroxylene is much more susceptible of reduction than

the former, and, therefore, a fractional or partial reduction may be effected, in which this only is converted. The corresponding nitroacetoxylides are easily obtained by the action of acetic anhydride upon the nitroxylidines. The melting points of these derivatives are 160° and 149° respectively. The nitroxylidines have been converted into the corresponding diamines; the melting points of the latter are 104° and 64 respectively. The former is obtained by the reducing action of stannous chloride; but to prepare the latter the nitroxylidine requires to be treated with tin and hydrochloric acid.

Triamidometaxylene, 1, 3-4, 6, 2 corresponding to the trinitro derivatives above described, was obtained from the latter by reduction with stannous chloride. It is an unstable compound, decomposing, when heated, at 140-150°.

Colouring Matters from the Di- and Triamines.—On diazotating these compounds, and employing the products for dyeing silk, in a soap bath, the shades obtained were red brown (diamine m.p. 64°); yellow brown (diamine m.p. 104°); olive green (triamine). With diazo-benzene sulphonic acid, the corresponding colouring matters obtained from these compounds were yellow orange, red orange, and reddish black. The results obtained in dyeing silk with these derivatives were, however, of a different order; the latter became a bright yellow; and deeper shades were obtained from the two former in the inverse order. The investigation of these products is proceeding.

Nitration of Metaxylidene, 1, 3-4. In presence of eight parts H_2SO_4, the two nitroxylidines previously described were obtained; the isomeride, melting at 78°, constituted ten per cent. of the mixture. From the nitroxylidines the amido group was eliminated by the action of ethyl-nitrite in presence of sulphuric acid and absolute alcohol. The resulting nitrometaxylenes complete the proof of the constitutional relationships of these several compounds, which are as follows:—

	1, 3-4, 6	1, 3-4, 2
Dinitroxylene	m.p. 93°	m.p. 82
Nitroxylidine	m.p. 123	m.p. 78
Diamine	m.p. 104	m.p. 64

—C. F. C.

The Production of Violet and Blue Colouring Matters of the Rosaniline Series by treating Aromatic Amines with Alkylised Amido Derivatives of Benzoyl Chloride. C. D. Abel, London. From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Eng. Pat. 4961*, March 15, 1884.

This is an amended specification of the patent No. 4961, of 1884, the amendment consisting in the excision of the second claim, and the parts relating thereto, which the inventors now declare to have been too broadly stated.—R. M.

Process for the Partial Separation of Schäffer's Monosulphonic Acid from the α-Monosulphonic Acid of β-Naphthol. H. J. Haddan, Westminster. From the Farbenfabriken vorm. Fr. Bayer & Co., Germany. Eng. Pat. 8390, May 29, 1884.

The object of this invention is to remove the greater part of Schäffer's acid from the β-naphthol-α-sulphonic acid by a cheaper process than the treatment of the sodium salts with alcohol. Three processes are given:—(1) By the fractional crystallisation of the Ba or Ca salt four-fifths of Schäffer's acid can be removed. (2) On neutralising the strong solution of the mixed acids with alkaline carbonates, four-fifths to five-sixths of the salt of Schäffer's acid separates out. (3) The mixed acids are mixed in the state of strong solution with about two-thirds the quantity of alkali necessary for neutralisation. On cooling, about four-fifths of the acid salt of Schäffer's acid separates. The filtrates obtained from either of these processes can, if necessary, be completely freed from the remaining traces of Schäffer's acid by any of the known methods, such as treatment with diazo salts, etc.—R. M.

Improvements in the Manufacture of Colouring Matters suitable for Dyeing and Printing. C. D. Abel, London. From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Eng. Pat. 8744, June 9, 1884.

This invention relates to the production of azo colouring matters from the diamido derivatives of "oxy-sulphobenzide." The preparation of these compounds is illustrated by the production of "diamido-oxysulpho-orthotoluide," one of the homologues, for which purpose two parts of orthocresol and one part H_2SO_4 are heated to 180° to 190° C. till a sample gives a solid precipitate with water. The oxysulpho-orthotoluide is then collected, washed and nitrated by boiling with dilute nitric acid. The dinitro compound is then reduced, and the diamido base is described as furnishing well-characterised crystalline salts. Substitution products, such as the dibromdiamido-oxysulphotoluide, etc., are obtained by brominating the dinitro compounds and then reducing. In order to prepare the colouring matters, the dilute solution of the hydrochloride of the base is diazotised and mixed with alkaline solutions of the naphthols, or other phenols, and their sulphonic acids.—R. M.

Improvements in the Process of combining certain Diazo Compounds with Phenol, Cresol, Naphthol and the Sulphonic Acids of these Bodies for the Production of Colouring Matters. A. M. Clark, London. From Wirth & Co., agents for Rudolph Krügener and the Farbfabrik vorm. Brönner, Frankfort-on-the-Main, Germany. Eng. Pat. 8806, June 10, 1884.

In the usual processes for combining diazo compounds with phenols, the former are mixed with the alkaline solution of the latter, kept cool by ice. According to the present invention, certain of the more stable diazo compounds, such as diazonaphthalenesulphonic acid and diazobenzenesulphonic acid, combine with naphthol and other phenols when dissolved in acetic acid in the presence of sodium acetate. The colours obtained by this method are said to be purer than those given when alkali is used, and the inventor claims, as an advantage, that the use of ice can be dispensed with. The colours are, moreover, said to be isomeric, and not identical with those precipitated by the alkaline method. Detailed examples, illustrating the mode of working, are given in the specification.—R. M.

Improvements in Producing Yellow Colouring Matter suitable for Dyeing and Printing. John Erskine, Glasgow. From the Farbenfabriken vorm. F. Bayer & Co., Germany. Eng. Pat. 9162, June 19, 1884.

The colouring matter in question is prepared by diazotising benzidine and combining the tetrazodiphenyl with salicylic acid, phenol or cresol. It is a fine yellow colouring matter, which dyes cotton in a boiling soap bath without the use of a mordant.—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Relative Value of Tartar Emetic and Antimony Oxalate as Mordants. G. Hirzel. Chem. Zeit. 9, 725.

The comparative tests made by dyeing with these two mordants show that for equal weights of antimony oxide in the two compounds, the tartar emetic produces the best effect, the acid character of the oxalate deteriorating from the brightness of the colour. The oxalate forms in a hot dilute solution a basic salt, which no longer combines with tannin, and, moreover, the oxalate calculated for the same weight of antimony is more costly than tartar emetic.—J. B. C.

Improvements in Bleaching. F. A. Gatty & Brother, Accrington. Eng. Pat. 8479, May 31, 1884.

This invention relates to a means of preserving the colours when bleaching fabrics made from white and

coloured yarns. The fabrics are run in an open beck or cistern for about 20 to 30 minutes in soap and water, at a temperature of 120° to 180° F., or more or less according to the colours. Oil or fat soap is used, and in such quantity as to give a froth on the water. After soaping, they are washed and squeezed, then passed through bleaching-liquor at 1° to 4° Tw., squeezed again, and then steamed for one or two minutes, as if for restoring whites after dyeing and printing. After steaming, the fabrics are washed and dried. Sometimes, when the colours can sustain it, the fabrics are passed through very dilute sulphuric or muriatic acid.—H. A. R.

Improvements in Bleaching. J. B. Thompson, New Cross, Kent. Eng. Pat. 9312, June 23, 1884.

THIS invention relates to improvements in the prevention of bowking stains, and the partial removal of the organic colouring matter in the material treated. Advantage is taken of the well-known affinity of aluminium in certain forms for vegetable-colouring matters. To the bowking alkali, aluminium is added in various forms—*e.g.*, as ordinary trihydrate, finely-powdered gibbsite, or even as finely-powdered kaolin, or finely-powdered cyanite. The first two are used with an alkaline carbonate, with the last two a caustic alkali may also be used, the proportions recommended being from 60lb. to 80lb. caustic soda to the ton of cloth, with about 80lb. of gibbsite or artificial trihydrate. Quantities and proportions vary according to material treated. Artificial trihydrate may also be formed on the fibre by precipitation from aluminium chloride, or another aluminium salt, on the cloth itself. In this case the cloth is piled direct from the aluminium solution into the boiling kier, and there treated by the soda-ash solution. After boiling for five or six hours, the material is thoroughly washed, and is then ready for treatment with calcium hypochlorite in conjunction with carbonic anhydride, according to Eng. Pats. 595 of February 3, 1883, and 4707 of March 11, 1884.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Decomposition of Salts by Water. H. le Chatelier. Compt. Rend. **100**, 737.

FROM general principles the author comes to the following conclusions:—(1) That the quantity of free acid necessary to prevent the decomposition by water of a dissolved salt must increase with the quantity of the salt present; (2) That the decomposition of a salt is increased or diminished by rise of temperature according as the decomposition is endothermal or exothermal.

The conclusions were quite borne out by experiments with mercuric sulphate and antimonious chloride. In the decomposition of mercuric sulphate heat is absorbed, and a rise of temperature increased the decomposition, whilst with antimonious chloride a small quantity of heat is evolved and the decomposition is diminished by rise of temperature.—A. G. G.

On the Preparation of Ammonia Gas. Isambert. Compt. Rend. **100**, 857.

THE reaction in the ordinary preparation of ammonia from NH_4Cl and CaO corresponds to an absorption of heat of 10·9cals., from which 7·55cals. are to be deducted for the formation of $Ca(OH)_2$. At ordinary temperatures no ammonia is set free, even in vacuô, but the compound $CaCl_2(NH_3)_2$ is formed, in the formation of which about 14cals. are evolved, and which only gives off ammonia at 180-200°. This is also the case with baryta and strontia; but with lead oxide, on the contrary, ammonia is evolved at the ordinary temperature, although the reaction requires an absorption of heat of 12·9cals. The author explains these phenomena by assuming a dissociation of the ammonium chloride; lime or lead oxide fix the hydrochloric acid even at ordinary temperatures, and cause to be yielded free ammonia or ammonia combined to form an ammonium-metallic-chloride. Barium and strontium do not act sensibly on the free acid below 180-200°. In the foregoing reactions, therefore, the heat of combination of NH_3 and HCl (42·5cals.) should not be taken into account, but the reaction is limited to the separation of the gases set free by a process of dissociation, the necessary heat being borrowed from neighbouring bodies. The formation of an ammonium-metallic-chloride rather hinders than aids the evolution of ammonia.—A. G. G.

The Preparation of Double Cyanides of Chromium and Manganese analogous to the Ferro- and Ferricyanides. Odin F. Christensen. J. f. Prakt. Chem. **31**, 163.

THE double cyanides of chromium and manganese have been already prepared by Ifridsburg, Kaiser, Eaton, Fittig and Descamps.

Potassium Chromicyanide $K_6Cr_2Cy_{12}$.—A solution of chromic acetate is prepared by dissolving freshly-precipitated chromic hydrate, from K_2CrO_7, in acetic acid; after removing the excess of acetic acid, potassium cyanide is added to the nearly boiling solution, filtered and allowed to crystallise. After recrystallisation it forms light yellow crystals.

Potassium Chromocyanide $K_8Cr_2Cy_{12}+6H_2O$ is prepared by the addition of potassium cyanide to a solution of chromous acetate formed by mixing solutions of sodium acetate and chromous chloride. It forms a dark-blue crystalline precipitate which is very oxidisable, so that air must be excluded in its preparation.

Potassium Manganicyanide $K_6Mn_2Cy_{12}$, prepared by dissolving manganic phosphate in potassium cyanide, and recrystallised from water containing potassium cyanide.

Potassium Manganicyanide $K_8Mn_2Cy_{12}+6H_2O$ was prepared according to the method of Eaton and Fittig. The salt is blue.—A. G. G.

The Basicity of Hyposulphuric Acid. H. Trey. J. f. Prakt. Chem. **31**, 223.

KOLBE was of the opinion that hyposulphuric acid (dithionic acid) was monobasic, as experiments made to prepare an acid salt, a salt with two bases, an acid ether or an acid amine gave negative results. According to Oswald, a difference exists between a mono- and a polybasic acid, the latter dissolving less readily certain slightly soluble compounds, in presence of the neutral salts of the polybasic acid in question, whereas the contrary is the case with a monobasic acid. A similar result might be expected by the action of the acids with their salts on methylacetate. The action of hyposulphuric acid was analogous to that of hydrochloric acid, and it is therefore monobasic. Its composition is therefore HSO_3, according to Kolbe $SO_2.OH$, in which sulphur acts as a pentad element.—J. B. C.

Solubility of Salts. Fr. Rüdorff. Ber. **18**, 1159.

IF a saturated solution of a mixture of two salts is prepared, and a large excess of either of the components is then added, dissolved by heat and left to crystallise out again, in the case of some pairs of salts the resulting solution will be found to contain a larger quantity of the salt added, but a smaller quantity of the other salt than before the addition; thus a replacement of the one salt by the other has taken place. This is always the case when the two salts used form with each other a double salt, or are isomorphous. For instance, a saturated solution was made of ammonium-aluminium sulphate, and to one portion of 20cc., 6grm. of aluminium sulphate were added, and to another equal portion 4grm. of ammonium sulphate; 100grm. of the solutions at 18° were then found to contain: (*a*) Original solution—1·42grm. $(NH_4)_2SO_4$ and 3·69grm. $Al_2(SO_4)_3$. (*b*) With excess of aluminium sulphate—0·45grm. $(NH_4)_2SO_4$ and 16·09grm. $Al_2(SO_4)_3$. (*c*) With excess of ammonium sulphate—20·81grm. $(NH_4)_2SO_4$ and 0·29grm. $Al_2(SO_4)_3$. Thus in (*b*) an expulsion of ammonium sulphate by aluminium sulphate has taken place, and in (*c*) an expulsion of aluminium sulphate by ammonium sulphate. Such pairs of salts are magnesium and zinc

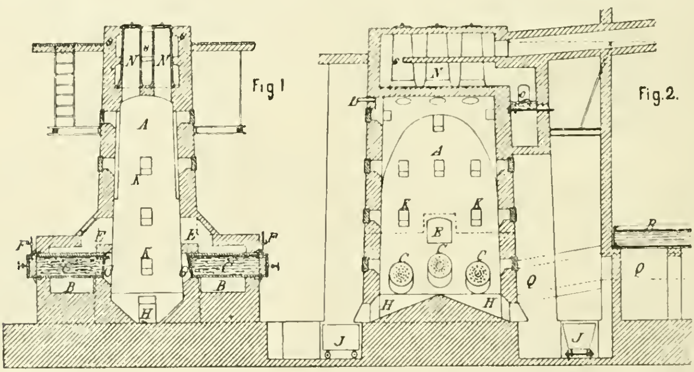
sulphates, cupric and ferrous sulphates, potassium and ammonium nitrates, ammonium-cadmium sulphate and ammonium-cupric sulphate, iron-ammonium alum and aluminium-ammonium alum, etc. On the other hand, in the case of salts which do not crystallise together, this expulsion does not take place, but the solution will contain the same proportion of the two salts independently of whether there is an excess of one or the other. Such pairs of salts are copper and cadmium sulphates, zinc and cadmium sulphates, copper and beryllium sulphates, lithium and copper sulphates, sodium and nickel sulphates, sodium and copper sulphates, sodium chloride and barium chloride, lead and sodium nitrates, sodium sulphate and sodium phosphate, etc.—A. G. G.

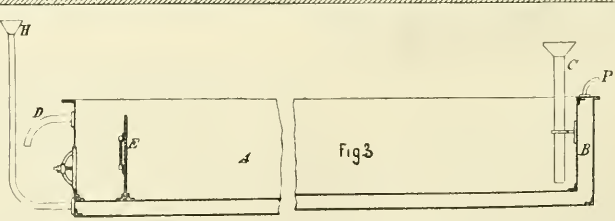
The Preparation of Strontium Oxide. H. Leplay. Dingl. Polyt. J. **256**, 169.

The author, having observed that in the decomposition of strontium carbonate by means of superheated steam, the strontium hydrate formed loses water at temperatures near its melting point, and is converted into a solid mass of strontium oxide, has devised the furnace and process here described for producing the oxide. The moist strontium carbonate moulded into suitable forms is deprived of a portion of its moisture and warmed in the retorts N placed above the decomposing furnace A. The interior of A is heated to redness by the furnace B, the gases from which enter A through E, charged with native carbonate of strontium in large lumps, and when the whole is sufficiently hot, the flues E are closed and the precipitation of sugar, a double pan of form shown in Fig. 3 is employed. The liquors flow into the inner pan A through C, are cooled by the aid of the current of water flowing through B in an opposite direction, deposit their strontium hydrate, which is collected by E, and flow away through D.—W. D. B.

On the Densities of Solutions of Pure and Commercial Aluminium Sulphate, and on the Solubility of Alum in Solutions of Aluminium Sulphate. Karl Reuss. Ber. **17**, 2888.

The materials from which alum was formerly prepared were Roman alunite and alum shale, both of which were roasted, the former yielding alum at once, the latter after addition of potassium sulphate. The percentage of aluminium sulphate in the alum obtained from the shale could not be determined from its density, on account of the large quantity of sulphate of iron present, and the strength of the alum was calculated from Poggiale's tables of solubility of potash alum. Now, however, alum and aluminium sulphate are usually prepared by treating bauxite and alunite with sulphuric acid. Bauxite yields a very pure aluminium sulphate, and alunite a concentrated solution of alum in aluminium sulphate, the latter being left behind in an almost pure state after crystallisation of the alum. The author gives tables representing the densities of solutions of pure and commercial aluminium sulphate, containing from 1 to 25 per cent. of sulphate, and at temperatures 15°, 25°, 35° and 45°. At 15° he finds the density of the pure solution to be re-





the hot gases from B led away through Q for purposes of evaporation. The lumps of partially dried carbonate are allowed to fall in from N, steam being introduced at F, superheated by passing through C, and liberated carbonic acid passing away through L. The strontium oxide formed is removed at the bottom of the furnace through doors H into waggons J. A fresh quantity of carbonate, equal to that removed at H, is introduced from N, the retorts in their turn being filled up. The process is thus practically continuous. Sight-holes K are provided at intervals. For separating the excess of strontium hydrate from the mother-liquors obtained in presented by the equation $d = 1{\cdot}007 + 0{\cdot}01p$, where p = percentage of pure anhydrous aluminium sulphate. Experiments on the solubility of alum in solutions of aluminium sulphate were made by adding 4, 3, 2 and 1 per cent. respectively of anhydrous potassium sulphate to solutions of aluminium sulphate of various strengths, heating the mixture to 80° and allowing to cool. With the larger quantities of potassium sulphate, alum separated in every case; with 1 per cent. very little crystallised from a 7 per cent. aluminium sulphate solution, and none at all from a 6 per cent. solution. The density of the 6 per cent. solution after addition of potassium sul-

phate was 1·083 at 15°. The author concludes that in order to use as little potassium sulphate as possible it is necessary to employ solutions of aluminium sulphate containing more than 7 per cent.—S. Y.

The Removal of Arsenic from Sulphuretted Hydrogen. Otto Frhr. v. d. Pfordten. Ber. **17**, 2897.

It is frequently necessary to obtain sulphuretted hydrogen free from arsenic, especially in cases of poisoning. Up to the present time it has been customary to employ materials perfectly free from arsenic, but ordinary ferrous sulphide is by far the most convenient substance which can be used, and it is not always easy to obtain hydrochloric acid quite free from arsenic, hence an easy method of removing arsenic from crude sulphuretted hydrogen would be of great advantage to chemists.

When sulphuretted hydrogen containing arseniuretted hydrogen is heated, three reactions may occur: The decomposition of the hydrogen sulphide, which takes place between 350° and 400°; the decomposition of arsine, which occurs at a higher temperature; and the mutual reaction of the two gases, forming arsenious sulphide and hydrogen, which is effected at 350-360°, but is not complete at this temperature, even when the gas is passed through a tube filled with charcoal. If, however, the impure gas is passed through a tube containing potassium polysulphides (liver of sulphur or potassa sulphurata) heated to 350°, the arsenic is completely removed. It was found best to heat the tube in an air bath. If the presence of hydrogen was not injurious, it was not necessary to maintain the temperature accurately at 350°. The gas was dried in the usual manner, and, after leaving the heated tube, was washed by passing it through a wash-bottle containing a solution of sodium carbonate. Numerous experiments showed that the removal of arsenic was complete, and that with ordinary reagents the tube need not exceed 30cm. in length. The author explains the reaction by the equation $2AsH_3 + 3K_2S_3 = 2AsS_3K_3 + 3H_2S$.
—S. Y.

On the Dissociation of Nitrogen Peroxide Gas. E. and L. Natanson. Ann. Phys. Chem. **24**, 454.

The authors have examined the specific heat and vapour density of nitrogen peroxide vapour under variable pressure and constant temperature. Kundt's method served for the determination of the specific heat. For measuring the vapour density the authors invented a special apparatus. The vapour was evolved in a closed space, which could be connected with another chamber as soon as the "equilibrium of dissociation" had taken place. In the second chamber air was approximately under the same pressure which prevailed in the first space. The small difference of pressure in the narrow connection tube, the pressure of the air in the second chamber, the cubic contents of the apparatus and the weight of the vapour are the data for calculating the vapour density. Further details, the mode of calculation and several results of experiments are to be found in the original paper. The observations were made at 21° C. and between the pressures of 43 and 640mm. The vapour density increases between these limits from 2·024 to 2·762, whereas the specific heat decreases from 1·274 to 1·172. Nitrogen peroxide thus behaves differently from carbonic acid, nitrous oxide, ammonia or ethylene, whose specific heats increase with rising pressure. The authors think these experiments a new argument of the view that the alteration of the density of nitrogen proxide vapour is due to the dissociation of N_2O_4 in NO_2.
—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Process for Glazing Dutch Tiles. Dingl. Polyt. J. **256**, 191.

According to Krzen, the air-dry tiles free from dust are washed with a solution of glue of 50° B., and allowed to dry in the air. 100 parts of potter's glaze, with 5 parts of white burning clay, are mixed with a sufficient quantity of a solution of glue prepared by diluting 1 part of glue solution of 50° B. with 3 parts of water. The tiles are immersed in this mixture and treated subsequently as usual. An addition of acetic acid is made to the glue solution to prevent its gelatinising, and also to obviate the too rapid setting of the glazing mixture. If the solution contain too much glue the proper distribution of the glaze is rendered difficult.—W. D. B.

On the Action of Strongly-compressed Carbonic Acid on Glass under the Influence of Light. L. Pfaundler. Ann. Phys. Chem. **24**, 493.

The author casually found that carbonic acid can attack glass under certain circumstances. The surface of a glass tube partially filled with liquid carbonic acid turned opaque in those places which were acted upon by the concentrated light of a Drummond lamp. This alteration already takes place after an action of a few minutes' duration. The opaque spots were always above the surface of the liquid carbonic acid, and the tube being partly immersed in a water-bath, nothing but light could have caused the opaqueness. This behaviour of carbonic acid may perhaps lead to an explanation of Bunsen's observation on the condensation of carbonic acid by glass surfaces (see Ann. Phys. Chem. N.F. xx. 545, and N.F. xxiv. 321; also Ber. 18, Ref. 249).
—S. H.

The Production of Milk-glass. A. Tedesco. Ger. Pat. 31,112, November 4, 1883.

The inventor proposes to employ an alkaline fluoride in the place of cryolite. The fluoride is most advantageously prepared by the incomplete saturation of carbonated or caustic alkalis with hydrofluoric acid and subsequent evaporation of the alkaline reacting product. The ordinary mixture for milk-glass consists of 25 parts of soda, 25 parts cryolite, 10 parts chalk, 170 parts sand. A precisely similar glass is obtained by the use of 33 parts of sodium fluoride, consisting of 90 per cent. of fluoride and 10 per cent. of carbonate, 5 parts of soda, 15 parts of china clay, 10 parts of chalk, 156 parts of sand. An alkaline fluoride may also be employed in the production of enamels for metallic surfaces.—W. D. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Preparation of Grey, Blue and Black Clay. Dr. Carl Bischof, of Wiesbaden. Deutsche Töpfer und Ziegler-Zeitung, **12**, 1885.

The manifold tints exhibited by different varieties of clay, as is well known, are mainly due to the admixture of carbonaceous or ferruginous matter. More particularly the latter—viz., the several oxides of iron cause the originally white silicate of alumina to change its colour, which is the more readily perceived on account of the moisture of the material. The grey, bluish, and even black colouring, caused by carbonaceous and other organic matter, disappears completely on burning with access of air. If white clay be triturated with bright and colourless water, such as distilled rain-, well-, or spring-water, and then after subsidence be collected on a filter, a residue of the original colour is obtained. Blue clay is not decolourised by digesting with hydrochloric acid. On heating, the colour at first appears more intense, owing to the separation of particles of carbon, but it finally disappears. Some other curious points were observed in connection with water containing brown peaty matter, which had been filtered. Finely-decanted Bohemian kaolin settles down extremely slowly when being mixed with such water. After 24 hours' standing,

the mixture was still distinctly turbid and milky, whilst the same clay, mixed with distilled water, had settled down completely. The following table explains what took place :—

Appearance of Water.	Bright Distilled Water.	Filtered Shallow Well Water.	Filtered Rain Water.	Clear, Filtered, Brown Water from Stagnant Pond.
After 12 hours....	Almost Bright.	Almost bright (opaque).	Slightly turbid.	Very turbid (milky).
,, 24 ,, ...	Bright.	Bright.	Almost bright.	Turbid.
,, 60 ,, ...	—	—	Bright.	,,
,, 8 days	—	—	—	Slightly turbid.
,, 12 ,, ...	—	—	—	Bright (faintly milky).

After such brown water has been treated several times with clay, its clarification becomes more and more rapid. The evolution of gas due to microbes, which always abound in such waters, probably tends to keep the particles of clay in suspension. Any affinity of the clay to the brown colouring matter, preventing the settling of the clay, is apparently lessened after a time, when the finest clay particles agglomerate more and more, whilst also they are saturated more rapidly with the colouring matter. Thus these particles subside more freely and rapidly. The colouration of clay, even by brown peaty water, is but a slow process. White kaolin was mixed with such a sample of water, and after eight days' standing, the slightly turbid liquid decanted. The residue having been transferred to a double paper filter, was of a brownish bluish tint, which became more distinct on being dried. Treated a second time in like manner, a brown residue resulted, and so on, until after ten repetitions of the treatment, a dark blue clay, with a brownish tint, was obtained, very similar in colour to many natural clays. The plasticity of clay is increased as the colouration gradually becomes more intense, and at the same time a faint lustre is perceived. Thus all the properties exhibited by natural coloured plastic clay are to some extent at least obtained by artificial means. As the plasticity increases, the clay after drying loses its power of staining one's fingers, but its hardness is increased.

—G. B.

Improvements in the Treatment of Slurry or Slip in the Manufacture of Portland Cement. H. Faija, Westminster. Eng. Pat. 2161, February 17, 1885.

According to this invention, the slurry, after it has left the wash mill, is treated in a centrifugal machine, revolving rapidly, and provided with a sieve, which may be of any desired fineness. The mechanical admixture of the raw materials, after they have left the wash mill, is thus completed most effectually, while small particles of chalk, such as in the wet process of manufacture would evidently be burned into free lime, and thus tend to produce a faulty cement, are removed from the slurry or slip.—E. G. C.

X.—METALLURGY, MINING, Etc.

Progress in Metallurgical Practice. Dingl. Polyt. J. 256, 227.

For the production of aluminium, Lauterborn charges a furnace with coke, brings this up to the requisite temperature with an air-blast, and then introduces a mixture of aluminium sulphate, sodium carbonate, and antimony sulphide. The following reactions are said to occur :—

(1.) $2Sb_2S_3 + 6Na_2CO_3 + 3C = 6Na_2S + 9CO_2 + 4Sb.$

(2.) $2Al_2(SO_4)_3 + 6Na_2S + 4Sb + 12C = 4Na_3SbS_3 + 4Al + 12CO_2.$

The sodium sulphantimoniate is fused with soda, and the antimony thus obtained in a condition suitable for repeated operations.

In order to obtain ammonia during the operation of removing tin and zinc from metal waste, Reinecken (Ger. Pat. Add. 30,254, March 8, 1884) employs an alkaline solution of a nitrate as solvent, thus :

$$4Sn + 6NaHO + 2NaNO_3 = 4Na_2SnO_3 + 2NH_3.$$

The last portions of tin are removed by treating the waste with a solution of ferric chloride and dilute hydrochloric acid. The tin is precipitated from the liquors obtained by means of zinc.

For the removal of gold and silver from copper regulus, Manhès (Ger. Pat. 30,419, July 22, 1884) grinds the latter to a powder, mixes with from 1 to 3 per cent. of ammonium chloride, and heats in a muffle to temperatures below redness, till ammoniacal fumes are no longer given off. The regulus has not altered in appearance, but the gold and silver are now in the form of chlorides, the iron and copper being still combined with sulphur. The chlorides of gold and silver are extracted by any of their solvents, preferably sodium thiosulphate.

Probert recommends the plan of melting arsenic and sulphur ores containing gold and silver with litharge or lead in crucibles lined with dolomite.

According to Howard's patent, copper ores are decomposed with a mixture of potassium hydrogen sulphate, fluoric acid, sodium nitrate, sulphuric acid, and water. The electricity thus generated is utilised in the precipitation of copper in another bath.

Referring to recent discoveries of gold in the island of Bömmelöen on the west coast of Norway, Weltz considers that there are slight grounds for the hope of obtaining the same in noteworthy amount. Traces of native gold have been found in Norway for forty years past.

Symons describes a plan adopted at Maidanpec, Servia, for the extraction of copper from poor ores, containing, upon an average, copper sulphide 1·05, blue and green carbonate 0·30, red copper ore 0·95, water 16·00 per cent. The ore was made into heaps of 300 tons, allowed to dry for a month, then roasted with seven tons of dry beechwood. The roasted mass was lixiviated, the copper precipitated from the liquors by cast-iron rods, cast into blocks, and brought into the market as black copper.

Brand contributes his experiments in relation to the steel-melting processes in acid and basic crucibles. The puddled iron (I.) and spiegel iron (II.) employed were composed as follows :—

	I.	II.
Silicon	0·079	0·888
Copper	0·090	0·141
Manganese	0·140	12·07
Nickel and Cobalt	0·043	0·169
Sulphur	0·030	0·012
Phosphorus	0·231	0·076
Carbon	0·020	4·25

Experiments were made with three different "acid" crucibles, and one "basic." The composition of the substance of the crucibles was found by analysis to be as under :—

	Acid.			Basic.
	(1) Coke-Clay.	(2) Graphite.	(3) Clay.	
Silicic Acid	42·78	24·63	53·92	4·8
Alumina	34·71	27·89	40·57	2·49
Magnesia	—	—	—	92·62
Sulphur	0·49	0·27	0·23	0·099
Carbon	18·60	40·43	—	—

The constituents of the charge worked in the coke-clay crucible, and of the steel obtained, were as under:—

	Charge.	Steel. Sampled when fusion was complete.	Steel. Sampled after 2½ hours' fusion.
Silicon	0·119	0·096	0·297
Copper	0·092	0·092	0·094
Manganese	0·74	0·360	0·380
Nickel and Cobalt	0·049	0·045	0·047
Sulphur	0·029	0·036	0·051
Phosphorus	0·223	0·223	0·224
Carbon	0·230	0·380	0·530
	1·482	1·232	1·623

The silicon, sulphur, and carbon in the charge, and steel of the graphite crucible were:—

	Charge.	Steel. Sampled 1hr. after fusion.	Steel. Sampled 1½hr. after fusion.
Silicon	0·119	0·211	0·296
Sulphur	0·029	0·035	0·039
Carbon	0·230	0·810	0·950

In the clay crucible the charge was made up of ninety-two parts soft iron, eight parts of spiegel iron. The analytical results were:—

	Charge.	Steel.	
Silicon	0·143	0·130	0·178
Sulphur	0·028	0·037	0·041
Carbon	0·360	0·330	0·280

The steel from these three crucibles was found to possess a medium grain on fracture, but owing to the high percentage of sulphur showed a tendency to "red-shortness." The above experiments, with different "acid" crucibles, lead to the following general conclusions: High quality steel is adversely affected most of all by sulphur, next by phosphorus and silicon. Copper, nickel, and cobalt have but slight influence, unless they are present in large amount. Their adverse influence can thus be readily prevented. Excess of manganese causes brittleness, but in amounts less than 1·5 per cent. this element partly neutralises the bad effects of silicon, sulphur, and phosphorus. The likelihood of phosphorus increasing during the melting process is but small, since the materials of which the crucible is ordinarily composed do not contain sufficient of this element in the forms of combination in which it can combine with iron. On the other hand, silicon and sulphur readily migrate from the crucible to the steel. Whilst silicon and phosphorus are able in some measure to perform the functions of carbon, carbon, and carbon alone, imparts to steel its elasticity. It follows that the crucible mass should contain as little sulphur as possible; it is also of importance that the amount of carbon should not exceed that which is actually required to give the clay porosity. In the experiments with the basic crucible the charge was composed of ninety-five per cent. of puddled iron, five per cent. of spiegel iron, lime being added to assist the formation of slag, and oxide of iron as the oxidising agent. The following are analyses of the charge and of samples of the steel taken at different intervals:—

	Charge.	Steel I.	Steel II.	Steel III.
Silicon	0·119	—	—	—
Copper	0·092	—	—	0·097
Manganese	0·740	trace	trace	—
Nickel and Cobalt	0·049	—	0·050	—
Sulphur	0·029	0·063	0·065	0·077
Phosphorus	0·223	0·090	0·050	0·043
Carbon	0·230	trace	—	0·018

The steel obtained in this experiment was soft and malleable, and a rolled plate of 1·75mm. in thickness could be subjected to much bending and twisting without fracture; owing, however, to the high percentage of sulphur, the tendency to "red-shortness" was distinct. From a comparison of the above four analyses it is evident that the reaction was practically completed during the melting up, the percentage of phosphorus alone subsequently undergoing any marked diminution. The difficulty with which phosphorus is oxidised and removed is explicable when it is remembered that ferric oxide is the oxidising agent. Copper, nickel, and cobalt have suffered no reduction; silicon has been completely removed, and the carbon in samples I. and II. is only present in traces. The increase of carbon in sample III. is ascribed by the author to accidental introduction. The increase in the percentage of sulphur is remarkable, and proves with what facility that element is transferred from the crucible to the charge. In this case the sulphur was derived from the tar employed in conjunction with the dolomite. The advisability of substituting other carbonaceous substance—as syrup—in place of tar is thus apparent. For the production of a chemically pure iron by a fusion process, a material free from copper, nickel, and cobalt, and containing only moderate amounts of sulphur and phosphorus, should be selected. The sulphur is eliminated by the addition of a considerable amount of manganese before the iron has lost its easy fusibility by removal of its carbon; the sulphide of manganese formed rises to the surface, and either unites with the slag or forms a regulus. The iron now contains only phosphorus, silicon, manganese, and carbon, and these can be eliminated by oxidation with oxide of iron in a basic crucible.—W. D. B.

Extracts from the Review of the Mining Industry during the first Quarter of 1885. Chem. Zeit. **9**, 745.

P. Manhès, of Lyons (*Chem. Zeit.* 1885, 9, 81; and Ger. Pat. 29,006) obtains nickel and cobalt (after fusion to eliminate gangue), by heating the polybasic sulphur and arsenic compounds of nickel, cobalt, and copper in the Bessemer converter until the iron is almost got rid of. The regulus is then treated with HCl or submitted to electrolysis or fusion. To obtain malleable ferronickel and ferrocobalt from crude nickel and cobalt ores, the latter are fused with cyanide of iron or yellow prussiate of potash and oxide of manganese, and a small quantity of aluminium is added before tapping.

Basse and Selve (*Berg- und Huttenm.-Zeit.* 1885, 44, 128) in Altena have taken out a patent for the manufacture of cube nickel and cobalt directly from the oxides, and from these malleable alloys may be prepared.

Stetefeld (*Chem. Zeit.* 1885, 9, 233) has sent several communications on the subject of Russell's process for extracting silver from ores in which the solubility of silver chloride in hyposulphite (thiosulphate) solutions is utilised, and the precipitation of such solutions by alkaline sulphides, the hyposulphite being reproduced. If the ore contain lead, the latter dissolves in the hyposulphite, and is precipitated with the silver. Russell found that lead carbonate is insoluble in sodium hyposulphite, silver and copper carbonate being soluble. The lead is therefore precipitated by sodium carbonate. A further factor to be considered in this method is that whereas a complete chlorination of the silver is necessary to the success of the process with hyposulphites (thiosulphates), the solution of double salts of copper and sodium hyposulphite dissolve considerable quantities of silver, silver sulphide and the compounds of silver with arsenic and antimony.

Möbius (*Chem. Zeit.* 1885, 9, 160; and Amer. Pat. 310,302) gives methods for purifying silver by electrolysis, and for the separation of gold with bromine and hydrobromic acid.

P. Manhès, of Lyons (*Chem. Zeit.* 1885, 9, 339; and Ger. Pat. 30,419), heats powdered gold and silver ores, without previously roasting with ammonium chloride, in order to convert the noble metals into chlorides.

Katterfeld, of Strassburg (*Chem. Zeit.* 1885, 9, 435), has published an interesting report on the platinum production of Russia, an industry which has increased largely in recent years.

N. W. Perry (*Chem. News*, 1885, 51 [1], 19, 31) has given an account of the occurrence, properties, and processes of fusing, casting, dephosphorisation and moulding of iridium.

F. A. Reinecken (*Chem. Zeit.* 1885, 9, 196; and Ger. Pat. 30,254) combines the process of recovering tin and zinc from metallic residues with the production of ammonia by heating these metals with nitre and alkali, thus forming sodium and ammonium stannates.—J. B. C.

Cellular Structure of Cast Steel. Osmond and Werth. Compt. Rend. **100**, 450.

Small plates of cast steel, from 0·02 to 0·03mm. thick, fixed to glass by means of Canada balsam, were treated with cold dilute nitric acid, when the iron dissolved, leaving a carbon compound behind. A microscopical examination of the plates showed that cast steel possesses a cellular structure, the iron occupying the interior, and the carbide of iron forming the cell wall. The cells unite to form groups, which, in the thin plates, are seen to be separated by empty spaces, and therefore possess no walls. If a bar of cast steel is dissolved at the positive pole of a Bunsen cell in dilute hydrochloric acid, the residue, consisting of small spangles, preserves the original form. These spangles form a network, the meshes of which were filled with iron. If a polished surface of cast steel is etched with concentrated nitric acid, the dendritic structure of the cell-groups is seen. In tempered steel, only simple cells are found. The interior of the cells is elongated by hammering, and the cell walls, which are but little extensible, more or less obliterated.—S. Y.

The Treatment of Basic Slags. H. Schüchtermann. Ger. Pat. 30,891, April 8, 1884.

Slags obtained from the basic process are finely divided, freed as far as possible from metallic iron, mixed with solution of calcium chloride, dried and calcined in presence of water vapour. Sulphuric, phosphoric and silicic acids, previously combined with oxides of the heavy metals, now enter into combination with lime, and the phosphates may be readily obtained therefrom by proceeding according to well-known methods.

—W. D. B.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Experiments with Lubricating Oils. S. Lamansky. Dingl. Polyt. J. **256**, 176.

In the experiments of which the results are to be enumerated first, the apparatus of Napoli and Deprez was employed, since with this it was possible always to subject known quantities of oil to the test. From the tabulated results of these experiments, the conclusions to be drawn are:—The coefficient of friction is dependent upon viscosity; liquid oils will not carry a heavy load, but have the smallest coefficient of friction; viscid oils, such as ricinus, among organic, and Glück cylinder oil among those of mineral origin, show a large coefficient of friction with a proportionately small load. These oils can only be employed successfully for the lubrication of light machinery when the parts in contact therewith are warmed. Experiments were also made by the aid of the same apparatus with oils of small viscosity—viz., sperm, olive, and a light mineral oil "oleonide,"—with a view of determining what relation obtained between velocity and friction. It was found that an increase of friction corresponds with an increase of velocity, but that the influence of velocity upon friction is more marked with small and heavy than with medium loads. The influence of temperature upon the lubricating powers of a large number of oils was studied by the aid of Thurston's apparatus. The coefficient of friction of mineral oils is easily influenced by changes of temperature, increase of temperature resulting in decrease of viscosity. In fact, the viscosity of ricinus, and the majority of mineral oils, is too readily affected by temperature for these to be regarded as first-class lubricants. In this respect sperm and olive oils show their superiority. The lubricating power of different mineral oils in the market, the viscosity of which varies between 55 and 70, differs very slightly, although these are sold at widely different prices. Among mineral oils, the author has found that petroleum residues will carry the greatest load, and on this account, and their low price, he recommends their employment in railway axle lubrication. A mixture of equal parts of rape oil and petroleum residues has a smaller coefficient of friction with all loads than the residues alone, but after a certain limit of load is reached, the coefficient of friction of the mixture is more sensitive to an increase of load than the petroleum alone. The author's experiments lead him to recommend, for heavy work, a mixture of equal parts of rape and "waggon" (mineral) oils; this is confirmed by practical experience on the French railways. Mineral and ricinus oils, which, by the aid of Thurston's apparatus, were found to possess a high coefficient of friction, when heated to 78° to 83°, gave excellent results, owing to their thereby decreased viscosity.

—W. D. B.

Extraction of Fat from Bones. Dr. Lorenz. Chem. Zeit. **9**, 484.

The author has tested the efficacy of the benzene fat-extraction process, introduced by Seltsam in 1880, and finds that the bones after treatment with benzene still contain 1·6 to 2·5 per cent (on the raw material) of fat, which can be extracted by a further treatment with benzene and 0·48-0·8 per cent., which is dissolved out by ether or a total of 2·08-3·2 per cent. of fat, which is lost in the actual process. This represents a loss of about 25 per cent. of fat. The author concludes that there is still room for considerable improvement in the method of extraction.—J. B. C.

On the Insoluble Residue formed by the Distillation of Castor Oil in Vacuo. F. Krafft and Th. Brunner. Ber. **17**, 2985.

This subject has been studied by several chemists, but their analyses of the product do not agree. The authors distilled castor oil both under reduced and at the ordinary pressure. The residue in the retort, which solidified suddenly, was extracted repeatedly with ether, and macerated between each extraction. The product, now scarcely elastic, was dried in two cases in the desiccator, in three others on the water-bath at a pressure of 15mm. The analyses agreed well together, and fairly with the composition $(C_{11}H_{20}O_2)_n$. They differ widely from those previously published. It appears from them that the product is a polymeric modification of undecylenic acid $C_{11}H_{20}O_2$; it shows gr at resemblance to Fittig and Engel's methacrylic acid. The product, which resembles caoutchouc, is easily saponified by alkalis, and when fused with potash yields nonylic acid. When heated to 50-60° with four times its weight of fuming nitric acid for several days, it forms sebacic acid. Undecylenic acid when similarly treated gives the same acids, so that the nature of the product is confirmed. When pure undecylenic acid is heated in closed tubes for some hours to 300°, and subsequently distilled, the residue in the retort solidifies suddenly to a light yellow amorphous mass. If, however, the acid, after being heated, is distilled under a pressure of 15mm., unaltered undecylenic passes over first, the temperature then rises rapidly 100°, and between 265° and 275° a product distils over which readily crystallises on cooling, while the above-mentioned yellow solid remains behind. The crystalline body was redistilled, the temperature being allowed to rise to 250°, pressed, and recrystallised from dilute alcohol in a freezing mixture. It melted at 29-30°, and its composition was found to be $(C_{11}H_{20}O_2)_n$, or the same as undecylenic acid. The silver salt has the composition $C_{22}H_{39}O_4Ag$. The acid is therefore monobasic.—S. Y.

Improvements in the Manufacture of Soap. W. Rodiger. Eng. Pat. 9012, June 16, 1884.

In order to neutralise the free caustic alkali usually present in soap, a strong solution of a bicarbonate of the same alkali (usually soda) is incorporated with the soap-paste at a temperature not far removed from 90° C.

—W. L. C.

Improvements in the Manufacture of Soap. A. Domeier and B. Nickels. Eng. Pat. 9375, June 24, 1884.

A COMPOUND termed in the specification "resinate of glycerine" is prepared by adding excess of powdered colophony to heated glycerine, and continuing to heat and stir for some hours. It may also be prepared by dissolving 4 per cent. of caustic soda in glycerine, and adding thereto 16 per cent. powdered colophony; about 15 per cent. or more of either mixture may be incorporated with soap in the usual way.—W. L. C.

Improvements in Lubricating Oils. Jakob Seeger. Eng. Pat. 13,512, October 13, 1884.

TALLOW, oil of turpentine, and cod-liver oil are mixed, and added to a solution of potash soap in warm dilute alcohol; the whole is stirred and cooled to 90° F., and rape oil is added to the mass. No quantities of the ingredients are given, but special qualities are claimed for the lubricant so produced.—W. L. C.

Improvements in the Preparation of Oils for Medicinal Purposes. W. G. Radley. Eng. Pat. 1399, January 31, 1885.

To cod-liver and castor oils the patentee adds caustic alkali to neutralise the oleic acid, and then mixes with this emulsion, sugar syrup, glycerin, and aromatic essences, in order to make them more palatable.
—W. L. C.

An Improved Method or Process of Purifying Fat and Oil. H. H. Lake. From J. P. A. Larson. Eng. Pat. 2100, February 14, 1885.

THE patentee renders fit for food various inferior fats, such as tallow and olive oil, by subjecting them to the successive action (1) of steam at 150-250 C., with or without a vacuum; (2) of a mixture of alumina salts and dilute sulphuric acid, at 100° C.; (3) of an alkaline carbonate; (4) of some weak oxidising agent at a low temperature, such as very dilute nitric acid, soluble chromates, etc.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Ultramarine-blue from Silica. Fr. Knapp. Journ. Prakt. Chem. **31**, 154.

THE author has failed to prepare ultramarine from silica without alumina.—A. G. G.

The Umber Deposits at Ashburton. R. J. Frecheville. Trans. Roy. Geol. Soc. (Cornwall), X. vii. 217.

THESE deposits occur at Ashburton, near Dartmoor, and occur closely associated with deposits of dolomitic limestone. By the alteration and decomposition of the latter the umber has been formed, and the change is indicated in the following analyses by Mr. J. J. Beringer. No. 1 is the analysis of a sample of unchanged limestone, No. 2 that of the umber in its natural state:—

No. 1.	Per cent.	No. 2.	Per cent.
Water (lost at 100° C.)	0·8	Water (lost at 100° C.)	65·0
Carbonate of lime	46·7	Combined water	4·8
Carbonate of magnesia	41·0	Lime	0·6
Silica	3·3	Silica	12·3
Carbonate of iron	2·6	Fe_2O_3	6·3
Carbonate of manganese	2·5	MnO_2	10·0
Undetermined and loss	3·1	Undetermined and loss	1·0

The carbonates of lime and magnesia have doubtless been removed by the solvent action of water containing carbonic acid, thus giving rise to the formation of deposits of umber from twenty to thirty feet in thickness. The deposit is worked by removing the over burden, consisting of from three to four feet in thickness of loam, and then sinking large rectangular pits in the umber till the unchanged rock is reached. The timber supporting the sides is then removed, the pit filled up, and another commenced alongside. The umber obtained, after being stamped in the usual manner, is ground under edge-runners, and the liquid mud pumped up to tanks, where it remains until it settles sufficiently to be dug out. The drying is then completed in a manner similar to that practised in the preparation of china clay. The umber is used for making the so-called silicate-oxide paints, as a colouring matter for the coarser kinds of cloth, and in the manufacture of brown paper. The output of umber from this deposit for the year 1883 was 2766 tons, the price of which delivered on rail at Ashburton averaged about 25s. per ton. Small deposits of umber have been found near Milton Abbot and at Veryan, seven or eight miles from Truro, in both cases as a result of the decay of limestone rocks.—W. S.

XIV.—AGRICULTURE, MANURES, Etc.

Composition of Unwholesome Meadow Hay. Morgen. Bied. Centr. **14**, 90-91.

THE hay in question, when used as fodder, caused the bones of the animals to become brittle. Two samples were taken and examined; they were found to be very deficient in lime and phosphoric acid. Taking moisture at fifteen per cent.—

	CaO	P_2O_5	Albumen.
Sample 1 contained	0·37 ...	0·20 ...	8·3 per cent.
,, 2 ,,	0·67 ...	0·26 ...	11·9 ,,

Sample 1 consisted almost entirely of inferior "acid" grasses and weeds, such as *nardus stricta*, *calluna vulgaris*, *carex panicea*, *potentilla*, *juncus* (rushes) and such like, with only two good grasses, *anthoxanthum odoratum* and *agrostis alba*, in very small quantities. Sample 2, with the larger amount of lime, etc., consisted mostly of marshy vegetation; but, nevertheless, with notable quantities of good grasses, such as *holcus lanatus*, *agrostis alba*, *lolium perenne*, etc. Thus it would seem that the amounts of lime and phosphoric acid present form a good indication of the wholesomeness or unwholesomeness of hay.—D. A. L.

Removal of the Bitterness from Lupines. F. Bente. Bied. Centr. **14**, 91-92.

LUPINES (100lb.) are immersed for twenty-four hours in dilute hydrochloric acid (containing for 100lb. lupines, 2lb. of strong acid), then a saturated solution of calcium sulphite (2lb.) is stirred in, and after twenty-four hours the liquid is poured off. The lupines are washed by repeated soaking in fresh quantities of water. The seeds, after treatment, are somewhat bleached, are odourless, and destitute of bitter taste. They are eaten readily by sheep, horses, cows and pigs, and when dried may be kept for a long time without spoiling. The air-dried lupine, after treatment, contains 37·28 per cent. albumenoids, and 3·38 per cent. of fat. The process here described occasions a loss of about twenty per cent.; but apparently not including much nutritive matter.—D. A. L.

Formation of Free Hydrochloric Acid in Plants. W. Detmer. Bied. Centr. **14**, 108-109.

THE author contends that the organic acids of plants are capable of decomposing metallic chlorides with the liberation of hydrochloric acid. And, as an example of this, he instances the fact that the addition of a trace of chloride promotes the action of diastase on starch, which he explains in the following manner:—The organic acids in the malt extract liberate hydrochloric acid, which favours diastatic action to greater extent than its equivalent of organic acids. If, however, citric acid, alone, and with chlorides, is added to malt extract, the activity of the diastase is greater in the first than in the second case, from which it is inferred that too much hydrochloric acid retards the diastatic action to a greater extent than its equivalent of organic acid. Definite experiments were now made to prove the decomposition of chlorides by organic acids; citric and oxalic acids were employed along with various chlorides. Methyl-aniline violet was used as indicator, inasmuch as it is much more readily affected by hydrochloric than by citric acid. (*a*) 15cc. distilled water, and (*b*) 15cc. distilled water containing 0·02grm. citric acid, (*c*) 0·7grm. potassium chloride, (*d*) 0·7grm. sodium chloride, (*e*) 0·02grm. citric acid and

0·7grm. potassium chloride, (*f*) 0·02grm. citric acid and 0·7grm. sodium chloride. After remaining 18 hours at a temperature of 20-25° C. the solutions were tested with methyl-aniline violet; the colour in (*a*), (*c*) and (*d*) was not changed, in (*b*) it was slightly changed, whilst in (*e*) and (*f*) it was changed to blue, or to the same extent as it would be by very dilute hydrochloric acid. Oxalic acid behaves in a similar manner to citric acid.—D. A. L.

Behaviour of Zinc Salts towards Plants and in the Soil. A. Baumann. Bied. Centr. **14**, 117-126.

In order to investigate thoroughly the much-contested question as to injurious or harmless effect of zinc salts on vegetable life, the author has made a series of water-culture experiments to study the effect, and the limits of the effect, of soluble zinc salts on various plants; and a series of experiments with soils and zinc salts to discover both the effect on the plant and the chemical changes produced in the soil. For the water-culture experiments the solution contained calcium and potassium nitrates, dipotassium phosphate, magnesium sulphate, and iron phosphate. To these zinc sulphate was added in various proportions, so that the four solutions contained 10, 5, 1, and 0·1 milligrams of metallic zinc per litre respectively. Thirteen plants of various kinds were experimented on. Starting from the seeds, these plants were germinated in a similar manner, selected as nearly alike as possible, and cultivated in the above solution at first without zinc. Observations made, when the zinc sulphate was given to the plant, showed the effect to be more injurious than was anticipated. All the plants resisted the influence of the smallest quantity of zinc, and only one—the radish (*raphanus sativus*)—died in the 1 milligram per litre solution. The following resisted the 1 milligram solution, but succumbed to the 5 milligram solution. They are arranged in the order of their susceptibility: Meadow clover, kidney vetch (*anthyllis vulneraria*), spurry (*spergula arvensis*), vetch (*vicia sativa*), barley, oats, cabbage *brassica oleracea*), mangold wurtzel (*beta vulgaris*), and buckwheat; whilst sanfoin is not affected by the 5 milligram solution, but dies in the 10 milligram solution. Finally, the 10 milligram solution kills all the plants; the clover in 16 days, barley in 30 days, vetch in 31 days, radish in 46 days, the sanfoin in 194 days. The other plants are intermediate in the order indicated above. The *coniferæ*, however (pine and fir), flourish even in the strongest zinc solution. Older plants perish sooner than the younger ones of the same kind. The action of the zinc always shows itself by a change in the colour of the leaves. The effect of zinc sulphate when applied to the soil is, however, quite different, and depends greatly on the character of the soil. To substantiate this statement the following plants—meadow cat's-tail grass (*phleum pratense*), oat grass (*avena arrhenatherum*), rye grass, soft meadow grass (*holcus lanatus*), field pea, sweet pea, and cabbage (*brassica oleracea*)—were grown in two kinds of soil, one a chalk soil rich in humus, the other a sandy soil free from humus and poor in lime. The plants were sown in pots, and representatives of each sort were watered daily, some with distilled water, some with a solution of zinc sulphate containing 20 milligrams of zinc per litre, and some with a solution containing double that quantity. In the sandy soil for the first six weeks all the plants were well, and those receiving strongest zinc solution looked most vigorous than any of the other plants. After this period the zinc plants fell off, and ultimately died, the grasses resisting for the longest time. In the calcareous soil matters were different, and not only were the zinc plants not killed, but they even surpassed in development those not receiving the zinc. The cause of these phenomena is plain; the sandy soil did not contain the necessary constituents to make the zinc harmless and insoluble, whilst the humus soil, on the other hand, absorbed the zinc, setting free other valuable plant foods, such as potassium, sodium, and magnesium in a soluble form. This conclusion was confirmed by experiments, wherein various soils were treated with zinc solution, and the quantity of zinc retained determined. The zinc absorbing power is greatest in soils rich in humus; then follow clayey and calcareous soils, then other soils according to their richness in alkaline earths and humus; finally comes poor sand soil, which has scarcely any retentive power at all for zinc. From direct experiments the author concludes that alumina has great zinc absorptive power without becoming soluble itself; zeolites also decompose zinc sulphate, whilst calcium and magnesium carbonates precipitate the whole of the zinc as carbonate. With regard to insoluble zinc salts, water cultivations with some of the plants mentioned above in solutions containing zinc carbonate or zinc sulphide, proved that these salts were equally as fatal as zinc sulphate, owing to the solubility of zinc carbonate in water containing carbonic anhydride, and to the fact that zinc sulphide under similar conditions is converted into carbonate. This solution does not take place in the presence of calcium carbonate, when it is present in proportions equal to or exceeding four of this salt to one of the zinc carbonate. For the sulphide the quantity required is somewhat less. Therefore, there is no solution of zinc likely to take place in the soil, any way not to any injurious extent, and the author's experiments prove, as well as those of previous investigators, that insoluble zinc salts in the soil are harmless to plants. If, however, a soil should contain considerable quantities of soluble zinc—as, for instance, near zinc mines and works—the author recommends the use of peat, heavy dressings of farmyard manure, and the application of clay, marl, or chalk. Certain zinc powders have been offered in the market for use on the soil; it is scarcely necessary to add that such an application is strongly deprecated. The poisonous action of the zinc on the vegetable organism evidently consists in a destruction of the chlorophyll colouring matter, inasmuch as neither the development of vegetation in the dark, nor the growth of plants containing no chlorophyll, is affected by zinc.—D. A. L.

Manurial Value of Peat Waste and Concentrated Liquors from the Strontium Sugar Factories. Märcker. Bied. Centr. **14**, 140.

This manure contains from 2·5 to 3·3 per cent. nitrogen, of which about 0·16 to 0·20 per cent. is derived from the peat, and is only of small value; the greater part comes from the roots in the form of nitrates, ammoniacal compounds, amides and amido-acid, and is of the same value as ammoniacal manures. The potash amounts to from 11·5 to 14 per cent., and as it is not accompanied by any of the other salts, which so frequently render the impure Stassfurt manures injurious, it forms an additional qualification to recommend the mixture of peat and waste liquor as a valuable manure.

—D. A. L.

Amount of Nourishment and Alkaloids in Different Varieties of Lupines. Dr. E. Flechsig and Dr. E. Taeuber. Die Landw. Versuch. 1883, 451.

Twelve varieties were grown under the same conditions of weather, manure, and soil; the seed was examined for proteids, fat, etc., and alkaloids, the straw for woody fibre, ash, etc. The most nitrogenous seeds were accompanied by the most nitrogenous straw, and the latter contains the largest proportion of ash. The figures are interesting, and should be consulted.—J. R.

Feeding Experiment with Lupines. Sachs. Landw Zeit. 1884, 441.

The Lupines had been treated by a patent process to remove bitterness, and were found to increase the yield of milk from a cow, but neither to injure it nor affect the flavour of the butter. Horses eat sparingly, and pigs refuse them.—J. R.

Manurial Value of Freshly-fallen Leaves of Trees. Emmerling, Loges, and Emeis. Bied. Centr. **14**, 87-90.

Freshly-fallen leaves from—1. grey poplar; 2. white willow; 3. silver poplar; 4. hornbeam; 5. birch; 6.

sycamore; 7. alder; 8. oak; 9. beech—were found to contain—

	1.	2.	3.	4.	
Water per cent.	20·88	20·27	18·34	17·03	
	5.	6.	7.	8.	9.
,, ,,	15·73	17·74	17·00	17·73	15·35

and in 100 parts of dry matter:—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Albumenoids	11·52	16·74	12·51	7·57	5·05	6·39	18·71	7·07	6·57
Fat	5·09	5·15	8·42	3·86	12·58	6·39	6·91	5·73	3·66
Carbo-hydrates	48·44	51·38	51·06	60·31	50·70	52·10	55·24	52·57	55·19
Woody fibre	26·44	19·72	20·16	24·83	29·10	28·31	15·74	30·68	29·82
Ash	7·51	7·01	7·55	3·43	2·57	6·81	3·40	3·95	4·46
Nitrogen	1·843	2·681	2·001	1·212	0·808	1·022	2·993	1·131	1·052

ASH CONSTITUENTS IN 100 PARTS OF DRY MATTER.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
K_2O	1·068	1·161	1·504	0·370	0·321	0·955	0·269	0·501	0·462
Na_2O	0·575	0·516	0·307	0·110	0·112	0·171	0·084	0·150	0·237
CaO	1·781	1·812	1·967	0·771	0·801	2·062	1·639	1·061	0·969
MgO	0·678	0·432	0·517	0·360	0·620	0·481	0·365	0·346	0·273
Fe_2O_3	0·078	0·205	0·095	0·157	0·068	0·069	0·122	0·081	0·078
Mn_3O_4	0·102	0·036	0·035	0·771	0·213	0·106	0·124	0·480	0·461
P_2O_5	0·356	0·512	0·398	0·197	0·080	0·163	0·189	0·159	0·207
SO_3	0·366	0·906	0·626	0·146	0·096	0·207	0·197	0·136	0·169
SiO_2	1·731	0·366	1·579	0·465	0·085	2·141	0·312	0·897	1·141
Cl	0·767	0·731	0·492	0·083	0·172	0·470	0·069	0·130	0·164

To compare these with one another, and with various straws, the analytical results were calculated on the mean percentage of water, 17·5 per cent., and from these figures the manurial value was obtained, by multiplying the amount of nitrogen by 5, phosphoric acid by 2, and potash by 1; manurial units are thus obtained of the value of 10 pfennigs (slightly more than one penny) each.

Leaves from	Percentages calculated. N	P_2O_5	K_2O	Manurial Units.	Value in Marks per Centner.
1. Grey poplar (*Populus canescens*)	1·52	0·31	0·92	9·14	0·91
2. White willow (*Salix alba*)	2·24	0·41	1·25	13·20	1·32
3. Silver poplar (*P. argentea*)	1·65	0·33	1·26	10·20	1·02
4. Hornbeam (*Carpinus Betulus*)	1·09	0·16	0·31	5·60	0·56
5. Birch (*Betula alba*)	0·670	0·067	0·270	3·70	0·37
6. Sycamore (*Acer Pseudo-platanus*)	0·81	0·14	0·80	5·30	0·53
7. Alder (*Alnus glutinosa*)	2·47	0·15	0·22	12·90	1·29
8. Oak (*Quercus Robur*)	0·93	0·13	0·42	5·30	0·53
9. Beech (*Fagus sylvatica*)	0·87	0·17	0·39	5·10	0·51
Oat straw	—	—	—	—	0·50
Rye straw	—	—	—	—	0·35
Barley straw	—	—	—	—	0·45

Hence, the ashes of poplar and willow leaves contained 5 to 5·7 per cent. of valuable plant food; the ash from sycamore 4 per cent.; whilst the proportion of these constituents in the other ashes amounted to from 2 to 2·3 per cent.; the first-mentioned leaves would therefore constitute an excellent fertiliser, even for a very impoverished soil. It is noteworthy that the beech-humus beneath the beech tree, resting on grey-sand formation, contained three times more nitrogen than the freshly-fallen leaves, whilst the mineral matter of the leaves was more than double that of the humus. Apparently, therefore, the dense network of surface roots of the beech tree are especially adapted for utilising the mineral matter set free by the decomposition of the freshly-fallen leaves, thus leaving the soil richer in nitrogen.—D. A. L.

Peat as Manure. Dr. Schriener-Triesdorf. Sächs. Landw. Zeit. 1884, 429.

THE author has for 10 years carried on experiments in wooden boxes sunk in the ground, each about 1 cub.-metre capacity, filled with about 13 cwt. of red sandstone; half the boxes received an addition of 5% peat earth. With oats the results were:—

	Pure Sand. Seed.	Pure Sand. Straw.	Sand with 5% Peat. Seed.	Sand with 5% Peat. Straw.
	grm.	grm.	grm.	grm.
Unmanured	8	27	71	170
Mineral Manure alone	14	53	91	277
Mineral Manure plus Nitrate of Soda	199	367	192	857
Mineral Manure plus Sulphate Ammonia	470	837	553	1073

The addition of peat yielded similar marked increase with barley, rye, buckwheat, peas, beans, potatoes, etc. —J. R.

Manuring Experiments with Precipitated Phosphate of Lime. Löbbecke-Marzhausen Landw. Zeit. u. Anz. 1884, 612.

IN agreement with previous experiments on light soils these experiments in 1882-83, with barley on a clayey

loam, and oats on a light soil, containing lime and humus, show that precipitated phosphate of lime, associated with nitrate of soda, is far superior to the former alone, or a mixture of it with superphosphate.—J. R.

Influence of Light upon the Germination of Seeds. A. Cieslar. Naturforscher, 1884, 156.

THE results showed that a few seeds (*viscous album*) will not germinate without light; others (barley, etc.) germinate equally in darkness or light; some (*Poa memoralis*, etc.) were assisted by light. Yellow light assisted germination, violet hindered it, white light caused a marked improvement.—J. R.

Chemical Analysis of the Outer Wood and Heart Wood of Various Trees. Dr. W. Daube. Forstliche Blätter, 20, 177.

IN trees the constituents separate into several concentric layers, vitality is confined to the outer wood, the inner wood seeming to take no further part in it. A sharp characteristic difference between the outer and inner wood is, however, not yet known, but the author sought to establish one, and selected trees of the following ages,—larch, 103; fir, 104; pine, 75; oak, 125; beech, 180. The relative amounts of oxygen, nitrogen, carbon, hydrogen, and ash were determined without establishing any essential difference, save in the pine, where the heart-wood contained 54% of carbon against 50% in the outer, and 39% oxygen against 43%. The author thinks this is due to the larger amount of resin in the heart-wood. The various mineral constituents were then determined, and showed potash always most abundant in the outer wood, phosphoric acid decidedly so; lime various, also magnesia; ferric oxide the same, sulphuric acid larger in amount in the outer wood, silica and soda in but slight quantity.—J. R.

Dissolved Wool. Dr. Märcker. Magd. Zeit. 1884, 121.

WOOL intimately intermixed with quicklime, and moistened with water, will, after 2 to 3 months, furnish a capital compost for autumn dressing. Wool can also be treated in lead-lined boxes, with sulphuric acid. This procedure, though dearer, acts quickly, and there is no loss of ammonia.—J. R.

Upon the Assimilability of Phosphoric Acid contained in Stones and Soil. G. Lechartier. Compt. Rend. **98**, 1058.

THE author has made experiments to show the direct assimilability of the phosphoric acid contained in stones freed from all organic matters.

The trial soils were composed partly of slate, partly of granite, the stones carefully washed, dried, powdered, and mixed, filled into flower-pots, and manured with a mineral manure composed of ammonium nitrate, calcium sulphate, and a potash salt, also one-half of the pots received phosphate, the other not; each pot was sown with five seeds of buckwheat, which together weighed 0·12-0·13grm., and contained 0·0012grm. phosphoric acid.

The table below gives the results:—

Employed.		Dry substance harvested.	Phosphoric acid harvested.
		Grm.	Grm.
Blue-grey compact slate, with 0·207 phosphoric acid..	without phosphoric acid	5·73	0·018
	with " "	21·85	0·257
Red slate, with 0·108 phosphoric acid............	without " "	9·41	0·051
	with " "	12·36	0·513
Granite, with 0·120 phosphoric acid..	without " "	9·71	0·076
	with " "	31·20	0·206

The added phosphoric acid considerably increased the yield, but the plants were evidently able to take up an important amount of phosphoric acid from the pure mineral.—J. R.

Comparative Trials with Peat Compost and Nitrate of Soda on Beet. Dr. L. Kuntze Spora. Neue Zeits. f. Rübenzucker Ind. 1884, 133.

LEYES from strontia-treated molasses were made into a compost by drying up with peat; the mixture, containing 2·5-3·3% nitrogen and 11·5-14% potash with good condition, was tried associated with Baker guano or superphosphate, against nitrate of soda with the same. With cereals no difference was produced. With beet good results were obtained in yield of roots and of sugar; and trials with various sorts of beet also showed that the compost with Baker guano gave a higher yield of crop and sugar than nitrate with Baker guano.—J. R.

The Absorption of Atmospheric Nitrogen by Plants. W. O. Atwater. Amer. Chem. J. **6**, 365.

IN order to decide the question whether plants growing under normal conditions are able to absorb a considerable weight of free or combined nitrogen from the air, peas were grown in washed and ignited sand, moistened with solutions of nitrogenous and mineral matter of known strength. The concentration of the solution, the absolute quantity of solid matter, and the proportion of nitrogen with mineral matter was varied in different experiments. The plants grew outside in the air, but protected from dew and rain. The excess of nitrogen found in the plants at the end of the experiments over the quantity of nitrogen which was in the seed and the solutions, represents the quantity of nitrogen taken from the atmosphere. Different experiments yielded an excess of nitrogen, which rose in one case to 51%. The greatest excess was found, if the concentration of the solutions did not interfere with a good thriving of the plants, and provided the supply of mineral matter was more than sufficient. In such cases there was a gain of nitrogen amounting to 50%. The author does not state his opinion how uncombined nitrogen can be absorbed by the plant, but only refers to experiments made by Berthelot, which show that electricity of such a tension as prevails on the surface of the earth in the air surrounding the plant can cause the absorption of free nitrogen by means of dextrine and cellulose.—S. H.

XV.—SUGARS, GUMS, STARCHES, Etc.

Experiments with Various Sorts of Sugar Beets. Dr. G. Liebscher. Bied. Centr. **13**, 774.

CARRIED out on deep loam, with 1cwt. of superphosphate ploughed in in autumn, and 1cwt. nitrate of soda in spring worked in by a cultivator. Average results according to yield of sugar placed the varieties as follows, the best being first: Kl Wanzlebener, Knauer's Elektoral, Wendelsteiner, Dornburger, Knauer's Imperial, Vilmorin, Stoebnitzer, Benkendorfer.—J. R.

The Part played by Animal Charcoal in Sugar Factories, specially as regards the Silicate of Lime. H. Pellet and A. Galvalowski. Bied. Centr. **13**, 711.

MANY factories have lately worked without animal charcoal, by careful special filtration; this in most cases has presented no difficulty, but in some the filters have soon been stopped up, and this according to the author is caused by the silica in the juice derived from the limestone employed, and specially from the coke used in burning the lime; for instance, a piece of original limestone contained 0·16 to 0·20 per cent. silica, and a piece of burnt lime 6½ per cent. A part of the silica dissolves in the juice, gradually separates during the evaporation, lining the pipes with a bad non-conductor, and the other part not so separated hinders the filtration. Examination of a three-kettle system gave 0·40 per cent. silicic acid in the deposits of the first, 23·40 per cent. silicic acid of the second, and 69·80 per cent. in deposits of the third. Juice thus containing silica, when filtered through charcoal, loses it, and on revivifying the charcoal used, the

latter is gradually made harder. The limestone should not be intermixed with the fuel, but be heated from the side.—J. R.

Preservation of Dried, Washed, Pressed Sugar-beet Sections. H. Hellriegel. Bied. Centr. **14**, 93-98.

SEVERAL series of experiments were instituted to investigate the subject suggested in the title. Various samples of pressed sugar-beet sections were taken. Samples were prepared as follows:—(1) dried slowly at 50°; (2) dried slowly at 100°, but not quite free from water; (3) samples which had been slowly dried were heated strongly and dried to excess; (4) fresh samples dried at first partially, then completely in current of air; (5) fresh samples heated strongly and dried to excess; (6) not sufficiently dried, remaining soft and containing 20 per cent. of water. To compare with these samples of clover and meadow hay, pea straw, rape, and earth-nut meal, dried to a somewhat similar extent as the sugar-beet samples, were also experimented on. These samples were subjected to various varying conditions of temperature and moisture for different periods. From time to time observations were made as to the growth or non-growth of mildew, loss or gain in moisture, and of the proportions of dry matter. From which numerous observations, the author concludes that the sections are not remarkably hygroscopic, and, in fact, are less so than many of our ordinary feeding-stuffs, such as clover and meadow hay. The sections are also not very prone to decomposition, and did not become mildewy as readily as oilcake and hay. Moreover, after eight months' storing under most unfavourable circumstances, they suffered less loss in dry matter than rape and earth-nut meal, and clover and meadow hay.—D. A. L.

Growth of Sugar-beet. B. Corenwinder. Bied. Centr. **14**, 113-115.

SUGAR-BEET were grown on a soil somewhat poor in phosphoric acid, plots were arranged without and with different manures. The application of 600kilos. ammonium sulphate per hectare increased the yield per hectare from 33,440kilos. to 51,750kilos. The same quantity of ammonium sulphate, with 400kilos. superphosphate, gave a yield of 55,400kilos., whilst sowing 200kilos. of magnesium sulphate, in addition to the above quantities of the other manures, yielded 54,900 kilos., showing that the magnesium salt was superfluous. The composition of the roots from all plots was about the same, and the author remarks that the plant evidently assimilates definite amounts of mineral constituents without reference to the supplies in the soil. Cultivations of sugar-beet were made in washed and ignited sand with (1) all the necessary constituents, and (2) with lime excluded. The yield of roots in the first case was more than double the yield in the second, although the weight of leaves was in the reverse order, whilst without lime the percentage of sugar in the roots was lower, but the ash per cent. was greater than with lime. It is of interest to note what a remarkable effect withholding this ingredient has on the growth of the plant in spite of the very small percentage of lime (0·037 to 0·04) contained in normally-grown roots. The author remarks that water-culture only gives trustworthy results with water plants, and that for other plants purified sand should be used as the cultivating medium.—D. A. L.

A Sugar and Betaïn from Cotton Cake. H. Ritthausen and Others. Bied. Centr. **14**, 132-133.

THE sugar is obtained by extracting cotton cake with 80 to 85 per cent. alcohol. It crystallises in needles, reduces Fehling only after heating with acid, and its rotatory power is $D\alpha = 104{\cdot}5$. This sugar is identical with the plus-sugar obtained from molasses by the strontium hydroxide process, also with Bohm's "gossypose," and Loiseau's "raffinose." Tollens does not recognise its identity with Berthelot's melitose, and therefore suggests the retention of the name raffinose. A betaïn, hydroxyquinoline, is obtained from the mother-liquor from the sugar by precipitation with platinic chloride. Bohm has obtained quinoline platinochloride, by precipitation, from cotton seed.
—D. A. L.

Composition of Starch-sugar Syrup, of Honey, and the Adulteration of the Latter. J. Sieben. Bied. Centr. **14**, 134-137.

STARCH syrup, when fermented with yeast, yields less alcohol than pure dextrose, but more than corresponds to the dextrose present in the syrup, hence some other sugar must take part in the fermentation, even if only incompletely. The residue from pure dextrose, after fermentation, does not reduce Fehling's solution; but that from dextrose syrup reduces it strongly. From other determinations, the syrup is found to consist of: dextrose, 21·97 per cent.; maltose, 15·80; dextrin, 41·96; water, 20·10; ash, 0·30. The author has examined sixty samples of genuine honey. In very many cases saccharose was absent, in other cases it was present in small quantities, in some it reached four per cent. and in one eight per cent. Dextrose and lævulose together compose about 68 to 78 per cent. of honey; the ratio they bear to one another, however, varies. The average composition of the sixty samples was:—Dextrose, 34·71 per cent.; lævulose, 39·24; saccharose, 1·08; water, 19·98; non-saccharine matter, 5·02. The author heats the honey with hydrochloric acid, which destroys the lævulose, with brown colouration, more readily than the dextrose, which can then be estimated alone. To detect adulteration of honey with starch syrup, the author proceeds as follows:—25grm. of honey are fermented for forty-eight hours with 12grm. of yeast free from starch and water, to make up 200cc.; aluminium hydroxide is then added, the solution made up to 250cc., and 200cc. of the filtrate are evaporated to 50cc. and examined in the polariscope. The presence of starch sugar will be indicated by dextro-rotation. When the residue from fermentation is heated with hydrochloric acid, the product should not reduce Fehling's solution, as honey contains no dextrin. The method mentioned above (heating with hydrochloric acid, etc.), and one wherein slight excess of Fehling's solution is used, and the filtrate examined after heating, are sometimes employed for detecting starch sugar in honey.—D. A. L.

On the Occurrence of Leucine and Tyrosine in Beetroot Molasses. E. O. von Lippmann. Ber. **17**, 2835.

SOME time ago the author observed the occurrence in the molasses of a monobasic acid, $C_5H_7NO_3$, identical with Schützenberger's glutiminic acid (*Ann. de Chim.* v. 16, 289) and probably with Haitinger's pyroglutaminic (*Wiener Monatshefte* 3, 228). The author concluded that the glutiminic acid, as well as aspartic and other nitrogenous acids were formed by the action of alkalis on the albumen of the beetroot. It is true that the beetroot itself contains asparagine and glutamine, but other characteristic decomposition products of albumen are found in the molasses, and probably the greater part of the nitrogenous constituents consist of such compounds. The author now describes the separation and identification of leucine and tyrosine. A quantity of the ammoniacal alcoholic waste liquor from the calcium saccharate, which is frequently allowed to accumulate in works, was neutralised with sulphuric acid and allowed to stand, when a compact precipitate formed. The liquid was drawn off and evaporated to a small bulk. The residue was dissolved in hot water, neutralised with lead acetate, and filtered. The filtrate, after removal of excess of lead with sulphuretted hydrogen, was evaporated, and the thick residue thrown into strong alcohol. A gummy precipitate was formed, and was purified by repeated digestion with strong alcohol. It was found to consist chiefly of dextrin. The alcoholic solutions left a clear syrup on evaporation, which dissolved completely in hot water. Lead acetate was added until no further precipitate formed, and the filtrate was decolourised with animal charcoal. The syrup deposited crystals, which were removed. The mother-liquor was further concentrated, and after stand-

ing some weeks yielded a second crop of crystals. The first-formed crystals consisted of tyrosine, the second of a mixture of tyrosine and leucine, which were easily separated by alcohol. The two substances were identified by analysis, and by a careful study of their properties. The optical properties of the tyrosine and leucine were examined by Professor Landolt, and the identity of the compounds with those obtained from animal matters was established. Schulze and Bosshard obtained active tyrosine and leucine, the former levo-, the latter dextrorotatory, by decomposing conglutine, prepared from the seeds of the lupin, with hydrochloric acid, but inactive compounds by decomposing conglutine with barium hydrate; but the active substances were obtained from beetroot by the action of lime or caustic alkalis. The author has observed the same decomposition products of the albuminates in the etiolated shoots of the beetroot as in those of other plants growing in the dark. The shoots were crushed and pressed, and the liquid was boiled, filtered and precipitated with alcohol. The precipitate contained asparagine, and from the filtrate, asparagine, tyrosine, leucine, glutaminic acid and aspartic acid were isolated. A single observation showed that the tyrosine was dextrorotatory, so that there are two optically isomeric tyrosines.—S. Y.

Purification of Refuse Water from Sugar Factories. Dr. A. Bodenbender. Braunschw. Landw. Zeit. **52**, 16.

THESE waters contain much suspended matter, nitrogenous and non-nitrogenous substances, also various salts, such as chlorides, phosphates, etc. Decomposition sets in readily. The author proposes to filter off the suspended matter, and then to treat the water with sulphate of alumina, magnesia, or protoxide of iron, or else ordinary superphosphate, afterwards adding lime to a weak alkaline reaction. The clear water can be run off, whilst the deposit yields a valuable manure. This treatment is good even for irrigation purposes, as the irrigation fields, not being overloaded with decomposing organic matter, will be effective much longer. Such water can be used for household purposes, or be with safety discharged into a small water course.—J. R.

Researches on Milk, Sugar, and Galactose. W. H. Kent and B. Tollens. Ann. **227**, 221.

THE authors prepare mucic acid by heating 100grm. coarsely-powdered milk sugar with 1200cc. nitric acid of sp. gr. 1·15 in a porcelain basin on the water-bath, until the volume is reduced to 150 or 200cc., or until the liquid has become thick. After cooling, 200cc. of water are added, and after standing some days, the mucic acid is filtered and washed with 500cc. of water. The yield is about 40grm. Milk sugar is converted by dilute hydrochloric or sulphuric acid into galactose and dextrose:

$$C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6.$$

The yield of mucic acid from 100grm. galactose, treated as above, is 77·4 per cent. When 10grm. of galactose are heated with 20cc. of hydrochloric acid of sp. gr. 1·12 to 100° for 5 hours, levulinic and formic acids are formed. By heating 3grm. of mucic acid with 10grm. of water to from 175 to 180° for 8 hours, it is decomposed, probably into dehydromucic acid, pyromucic and other bodies. —S. Y.

XVI.—BREWING, WINES, SPIRITS. Etc.

How Sulphur acts against the Oidium Fungoid. E. Mach and Portele. Die Weinlaube, 1884, 349.

RECENT experiments confirm the previous conclusions of J. Moritz, that sulphur acts by formation of sulphurous acid, which formation is much assisted by elevation of temperature.—J. R.

Comparison of Barleys of Various Countries. L. Marx. Zeits. f. d. Ges. Brauwesen, 1884, 375.

THE author has examined over 400 barleys of the last 6 harvests of various countries, for the protein compounds and phosphoric acid. The proteids vary from 9·60% to 12·76%; the phosphoric acid from 0·913% to 1·911%; Russia and Baden being highest, England and Austria lowest. No connection was found between the amounts of proteids and phosphoric acid; these both vary much, and whether a barley be rich in them can only be determined chemically, as a country will produce barley at one time rich and at another time poor in these constituents.—J. R.

Production of Maltose. L. Cuisinier. Chem. Centr. **15**, 413.

DISTILLED water is best. Water containing calcium bicarbonate or gypsum must be freed from these; a water extract from green malt should be used. Directions are given for dissolving up the starch by use of water, malt extract, stirring and regulated temperature. Finally, the syrup is to be filtered and concentrated.—J. R.

Plastering Wine. J. Erdélyi. Die Weinlaube, 1884, 340.

AN experiment to show whether the colour and keeping power of wine is increased by plastering. The result was negative, and in author's opinion even injurious. —J. R.

The Influence of Grape Stones upon the Tannin of Red Wine. Dr. J. Nessler. Bied. Centr. **13**, 862.

RESULTS show that the skins which rise to the top, and the stones which fall to the bottom, should both be thoroughly stirred up in the wine some three or four times daily.—J. R.

Correction of Acidities in Wine. Dr. P. Wagner and Dr. F. Becker. Beid. Centr. **13**, 862.

NUMEROUS experiments show that the addition of alcohol, neutral tartrate of potash, potassium carbonate or bicarbonate, powdered marble, chalk, or oyster shells, are, for various reasons, injurious, but chemically pure calcium carbonate may be used in proportion to the amount of free tartaric acid present.—J. R.

Contributions to the Chemistry of Malting and Manufacture of Spirits. Prof. Behrend, of Hohenheim. Bied. Centr. **14**, 51.

THE first part of this paper treats of the *extraction of inorganic and organic matter by the "steeping water."* Three kinds of barley were experimented on—Saxon, Bohemian, and Hungarian, and 1000 dried grains of each of these contained respectively 40·22, 35·82, and 33·44 grams. In the experiments ten litres of water were poured on 10 kilograms of barley contained in a suitable conical tin vessel provided with an outlet for water at the lower end. After 14 hours the first "steeping water" was run off and measured. The deficiency from 10 litres represented the quantity of water retained by the grains. It seems that the small grains retain slightly more water than the larger kinds. A second 10 litres of water were then added, and replaced after 24 hours by a third 10 litres. The third "steeping water" likewise remained 24 hours in contact with the barley, which was then fully steeped. Aliquot volumes of the three steeping waters were evaporated, dried at 110° to 115° C., weighed, burnt, and again weighed. The weights thus obtained gave total solids, and the inorganic and organic matter extracted. The water employed was exceptionally hard, and contained per litre 0·056grm. organic, and 0·354grm. inorganic matter. The results are tabulated in the original; they indicate that the first "steeping water" extracts the largest quantity of solid matter from the barley, whilst the third extracts the least, but nevertheless a considerable quantity. They, moreover, show that the first two "waters" extract more inorganic than organic matter, whereas the third "water" contains more organic than inorganic matter, and the total combined waters about equal amounts of each. And another point of special interest to the brewer is evident from these results—namely, that the smaller

grains yield more to the water than the large ones do, no matter from what standpoint the case is viewed; thus Saxon barley gives up 0·55 per cent. of its dry matter, Bohemian 0·63, Hungarian 0·79. The author gives a full explanation of these phenomena, attributing all to osmotic action. Owing to the large removal of nutritious matter by the "steeping water," prolonged steeping, especially in the case of small grain, should be avoided in practice.

In the second part of this paper *the changes produced by germination in the nitrogenous matter of barley* are investigated. In these experiments the Saxon and Hungarian barley, mentioned above, were employed. A preliminary experiment showed that the conversion of insoluble into soluble nitrogenous matter takes place very rapidly. In other experiments the grain was steeped for 36 hours, using two successive lots of water. It was then spread in layers about 2cm. deep to germinate. At various periodical stages carefully selected samples were taken, and total nitrogen, nitrogen soluble in water, and non-albumenoid nitrogen determined in them. All nitrogen determinations were made by Kjeldahl's method, which was found very satisfactory. The non-albumenoid solution was prepared by boiling the aqueous extract with ferric acetate, and filtering off the precipitated albumen. The results are tabulated below:—

V. was "ripe"; VI., "slightly over-grown"; VII., "distinctly over-grown"; VIII., "much over-grown." The nitrogen figures not determined were obtained by calculation from those determined. All losses between stages I. and II. are due to the "steeping water" (see above), whilst loss in dry matter is due to respiration. With regard to the nitrogen, it is evident that the total quantity remains constant throughout germination, whilst the soluble albumenoid and non-albumenoid show a steady increase; the total albumenoid and the insoluble albuminoid decrease. The greatest diastic power of the malt, as indicated by the soluble albumenoids calculated on the original dry matter, is about stage VI. with the Saxon, and stage V. with the Hungarian barley, or those stages where the albumenoid was coming soluble as quickly or more quickly than it was being decomposed. In most other stages the decomposition greatly exceeds the solution of albumen.

The third part of the paper is devoted to the description of experiments, results, and conclusions relating to *the changes produced in the albumenoid matter of various seeds and of potatoes, by steaming under pressure.* The materials experimented on were reduced to a fine meal, and digested with water in Lintner pressure flasks, at 140° C., for six hours; when the flasks were opened there was neither pressure of gas nor odour of volatile amines. The various nitrogen determinations (see above) were

CHANGES PRODUCED IN THE NITROGENOUS MATTER BY GERMINATION OF SAXON (LARGE-GRAIN) BARLEY.

Stage.	Period of Germination.	100 Barley Grains contain		Per Cent. Nitrogen in the Dry Matter.					
							Albumenoid.		
		Grams. Dry Matter.	M grams. Nitrogen.	Total.	Soluble in Water.	Non-albumenoid	Soluble.	Insoluble.	Total.
I.	Original Barley....	1·025	71·0	1·838	0·332	0·178	0·154	1·506	1·660
II.	Fully steeped.....	3·871	70·1	1·811	0·212	0·167	0·045	1·599	1·644
III.	After 22 hours......	3·814	69·2	1·814	0·217	0·159	0·056	1·599	1·655
IV.	After 62 hours......	3·805	69·6	1·828	0·381	0·298	0·083	1·477	1·530
V.	After 86 hours......	3·632	70·1	1·931	0·451	0·347	0·104	1·480	1·581
VI.	After 134 hours	3·430	69·8	2·035	1·045	0·189	0·556	0·990	1·546

Stage III., the root sprouts had appeared; stage IV., root sprouts were as long as the barley grain, stock sprout ⅔ that length; stage V., root sprouts were 1½ and stock sprouts ¾ the length of the barley grain; stage VI., was "slightly over-grown malt," with most root sprouts twice as long as a barley grain, some stock sprouts beginning to shoot.

made both before and after the experiments, with the results tabulated on p. 414, per 100 of dry matter.

The soluble nitrogenous matter was increased in all cases by the heating, especially with lupines and peas; but, whereas with the former the increase in the non-albumenoid nitrogen is greater than the increase in the amount of soluble albumen, with the latter the reverse is

CHANGES PRODUCED IN THE NITROGENOUS MATTER BY GERMINATION OF HUNGARIAN (SMALL-GRAIN) BARLEY.

Stage.	Period of Germination.	100 Barley Grains contain		Per Cent. Nitrogen in the Dry Matter.					
							Albumenoid.		
		Grams. Dry Matter.	M grams. Nitrogen.	Total.	Soluble in Water.	Non-albumenoid	Soluble.	Insoluble.	Total.
I.	Original Barley....	3·344	76·6	2·29	0·30	0·12	0·18	1·99	2·17
II.	Fully steeped......	3·319	71·0	2·23	0 24	0·12	0·12	1·99	2·11
III.	41 hours	3·153	74·4	2·36	0·40	0·18	0·22	1·96	2·18
IV.	89 hours	3·115	74·5	2 37	0·79	0·43	0·36	1·58	1·94
V.	113 hours	3·021	74·6	2·47	0·87	0·51	0·36	1·60	1·96
VI.	137 hours	2·920	74·2	2·56	0 92	0·61	0·31	1·62	1·93
VII.	185 hours	—	—	2·65	1·08	0·67	0·41	1·57	1·98
VIII.	209 hours	—	—	2·68	1·11	0·74	0·37	1·57	1·94

Stages I., II., and III. were similar to those with the Saxon barley; as malt, stage IV. was "not ready";

the case, and the solution exceeds the decomposition of the albumenoids. Maize and dari are likewise affected to

a considerable extent, but not so much as the leguminous seeds; the potatoes had been dried at 110°, therefore, the albumen had been rendered insoluble, a state of things which was not much improved by the heating under pressure. The staleness or freshness of the potatoes does not appear to affect the results to any considerable extent. The results indicate that the albumenoid matter of the above materials is both dissolved and decomposed by steaming under pressure; moreover, the albumenoid matter in the different materials is not affected to the same extent. With regard to the solution, the solution of albumen precedes decomposition, a fact confirmed by other experiments, when steaming under pressure for a short time dissolved albumen; whereas, continuing the heating converted the albumen into amides. To test the effect of bulk of material, some experiments were conducted on a manufacturing scale; maize and dari were gradually heated in a Henze's pressure boiler, until pressure of steam indicated four atmospheres. The changes in the albumenoids were similar to those in the smaller experiments, but not so marked, owing to the shorter duration of the experiment—just over two hours. In practice it is, therefore, advisable not to prolong the period of heating with superheated steam, for the decomposition of the albumenoids, as well as fats, reduces the value of the spent product for cattle feeding; the yeast, however, thrives better with amides than with albumenoids as nitrogenous food.—D. A. L.

CHANGES PRODUCED IN ALBUMENOIDS BY STEAMING UNDER PRESSURE.

Material.	Total Nitrogen	Before Heating under Pressure.					After Heating under Pressure.				
		Nitrogen.		Albumenoid Nitrogen.			Nitrogen.		Albumenoid Nitrogen.		
		Soluble.	Non-Albumenoid.	Soluble.	In-soluble.	Total.	Soluble.	Non-Albumenoid.	Soluble.	In-soluble.	Total.
Lupin	8·51	3·03	0·67	2·36	5·48	7·84	6·23	2·69	3·51	2·28	5·82
Pea	4·26	1·49	0·45	1·01	2·77	3·81	3·71	1·14	2·60	0·52	3·12
Maize	2·08	0·32	0·20	0·12	1·76	1·88	0·80	0·55	0·25	1·28	1·53
Dari (*sorghum tataricum*)..	1·40	0·15	0·13	0·02	1·25	1·27	0·61	0·43	0·21	0·76	0·97
Old Potatoes*	1·23	0·72	0·47	0·25	0·57	0·76	0·86	0·56	0·30	0·37	0·67
New Potatoes†	1·13	0·76	0·58	0·18	0·67	0·85	1·02	0·60	0·42	0·41	0·83

* A year after harvesting. † Freshly harvested.

Action of Sulphur on Wine, and Means for removing and keeping away Acetic and other Fungoids. J. Nessler. Bied. Centr. **14**, 135, 132.

When flowers of sulphur are sprinkled over the fungoid termed *kahnen*, on the surface of wine their development is stopped or retarded, but at the same time hydrogen sulphide is evolved, which gives a bad odour to the wine. The same gas is evolved when free sulphur is present in most or fermenting wine. The author recommends the use of sulphurous acid, which is efficient for destroying and keeping away the fungi, and is not accompanied by the disagreeable hydrogen sulphide. The author has a patent apparatus for the application of the sulphurous anhydride, which can also be used for its liquefaction.—D. A. L.

Feeding Value of Brewers' Grains. J. König. Bied. Centr. **14**, 141.

Three samples of brewers' grains had the following composition per cent:—

	I.	II.	III.
Water..	12·61	6·26	9·66
Albumenoids..................................	21·19	21·69	19·60
Fat	6·76	8·06	9·73
Non-nitrogenous extractive matter...	33·86	44·32	39·35
Woody fibre	17·12	15·00	17·62
Ash...	8·46	4·67	4·04

Valuing 1kilo. of fat and albumenoids at 32·5 pfennigs, and 1kilo. of non-nitrogenous nutritive matter at 6·5 pfennigs, the three would have the respective values, 9·88, 9·37, and 9·22 marks per 100kilos.—D. A. L.

Improvements in the Mode of and Apparatus for Cleansing Beer. A. G. Southby, Jersey. Eng. Pat. 764, January 5, 1884.

This relates to improvements in the mode of and apparatus for cleansing beer, either in the fermenting vat or in casks and pontoons. In the first case the pulpy yeast is pumped from the surface of the beer, and by a force pump forced into filter bags or yeast presses, the liquid beer which drains away from these being either returned directly to the vat or otherwise utilised. The suction pipe may be connected with the pipe leading from a parachute, or may dip down to the lowest part of a vessel suspended at the surface of the beer, the yeast being swept in by means of a revolving radial skimmer. When the beer is cleansed in casks or pontoons, the yeast trough or shoot or stillion into which the yeast falls from the casks, is made with a bottom sloping sufficiently for the yeast to run down into a well, from which it is pumped and forced into filter bags or yeast presses. The beer draining from these is returned to the cleansing casks.—W. D. B.

Improvements in Treating Grain for Brewing and Analogous Purposes, and in Apparatus therefor. E. R. Southby, London. Eng. Pat. 1269, January 11, 1884.

The object of this invention is to prepare grain otherwise than by malting, that it may be ground up and mashed with malt as if malt alone were being worked. The treatment is advantageously applicable only to those grains—viz., barley, wheat, rye, and oats—the starch of which can without previous cooking be converted by the action of malt into sugar and dextrin. The grain, sufficiently moist to render the corns tough, is passed between rolls until the corns are flattened out and their structure disintegrated, without, however, their being reduced to powder. The crushed grain is kiln-dried at a temperature not exceeding 100°, until sufficiently desiccated to grind easily when passed through the malt rolls. The above processes are carried out by means of roller-mill and kiln described.—W. D. B.

Improvements in the Treatment of Malt and other Grain. A. Schnell Lochbach Burgdorf, Switzerland. Eng. Pat. 7981, May 20, 1884.

The object of this patent is the saving of time in the processes of steeping, germination, and drying in the manufacture of malt, and the mechanical appliances for carrying this into effect. A wheel or cylinder, the rim of which is provided with a number of cells, the sides of

which are perforated, revolves slowly, running on rollers. The grain to be malted is dropped into the cells from above, and a lid prevents the grain from dropping out during the rotation of the cylinder. The lower part of the apparatus dips into water so that the grain becomes moistened, and as the apparatus revolves slowly during its passage through the air germination takes place. The grain is finally dropped into a truck running into the interior of the cylinder by opening a door on the inside of the cell. The same apparatus may be used for drying the malt by passing a current of hot air through it during motion, and after the steeping tank has been drained off. The patentee claims (1) the arrangement as described for malting the grain; (2) the arrangement as described for drying the grain after the operation of malting; (3) the application of the apparatus for soaking, husking, washing, drying, and torrefying other grain besides malt.—C. C. H.

Improvements in the Treatment of Alcoholic Spirits. R. R. Tatlock, Glasgow. Eng. Pat. 8851, June 11, 1884.

To remove the harsh smell and taste particularly peculiar to new spirits, the patentee proposes to add thereto a small quantity of caustic soda, potash, or ammonia, and to neutralise the alkalis by a little acetic acid. The presence of the acid prevents the spirit from becoming yellow or discoloured. The alkali may be previously added to a small quantity of the spirit, or to the bulk without such previous admixture. Any salt having an alkaline reaction will serve the purpose, and any ordinary acid may be used in the place of the acetic acid, though not with the same advantage. The patentee claims (1) the process of treatment by means of caustic alkali; (2) the treatment by caustic alkali succeeded by the addition of an acid.—C. C. H.

XVII.—PRESERVING FOOD, MEATS, Etc.

Improvements in the Manufacture or Treatment of Cocoa. W. L. Wise, London. From P. Lobeck, Germany. Eng. Pat. 8625, June 5, 1884.

The cocoa beans, either raw, roasted, shelled, ground, or otherwise prepared, are subjected for about thirty minutes to a temperature of 150° Centigrade and a pressure of from 5 to 6 atmospheres. The operation is effected in closed vessels, which may be of copper tinned on the inside. The following changes take place:—Firstly, the albumenoids present in the bean are converted into products soluble in water; and, secondly, the starch is changed into soluble dextrine and glucose. This conversion into soluble products probably extends to other constituents of the cocoa, which is thus rendered easily digestible, and capable of being made into a beverage ready for the table, by the simple addition of boiling water or milk. The inventor claims as the advantages of this method of treating the bean, that no alkaline carbonates are added (as is frequently the practice, with the view of rendering cocoa soluble), and that the aroma and taste peculiar to cocoa are exhibited in their greatest intensity and purity.—E. G. C.

Method of Preserving Meat. Cecil Russell, Tooting. From A. Losasso, Calcutta. Eng. Pat. 1534, February 4, 1885.

Joints of meat, or whole carcases, as the case may be, are placed in casks, or tanks, and covered with a cold, strong aqueous infusion of Mocha coffee. The vessels are then closed, and the meat is ready for storage or transport; thus preserved it will keep fresh for months, and when required for use it will be removed from the casks or tanks and washed in cold water. One ounce of Mocha coffee may be allowed for each pint of water. This invention also applies to the preservation of game, fish, and other perishable articles of food.—E. G. C.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

Process and Apparatus for Deodorising the Fumes of Cement and other Kilns. E. and A. Asby, Southampton and Grantham. Eng. Pat. 8212, May 26, 1884.

The contents of the kiln are first raised to a moderate heat, sufficient to drive off organic matter, accompanied by a small proportion only of carbonic anhydride. These fumes are passed through a retort or furnace chamber, containing coke or other fuel kept in a state of incandescence by an adequate supply of burning fuel. The fumes in passing through the incandescent fuel have their carbonic anhydride converted into carbonic oxide, which is burnt, with the other ingredients of the vapours or fumes. The hot gaseous products from the furnace chamber, and those direct from the kiln, may be conducted, on their way to the chimney or other exhausting apparatus, under suitable floors, so that the heat can be partly utilised for drying the slurry or other matter placed thereon, preparatory to its being treated in the kiln.—E. G. C.

Hygienic or Sanitary Concrete for Paving and other Purposes. J. Tottrell, Dublin. Eng. Pat. 8317, May 28, 1884.

Powerful disinfectants, such as carbolic acid, carbolates, sulphites, sulphates, bleaching powder, or other purifying, oxidising, and antiseptic substances, are mixed, either in a solid or liquid form, with the ordinary cements employed in paving roadways, and for floors, basements, foundations, walls, and the like.—E. G. C.

An Improved Disinfectant. J. Y. Johnson, London. From E. O. Beck, Paris. Eng. Pat. 14,864, November 14, 1884.

Air or oxygen is caused, by suitable means, to pass through a liquid composed of water and spirit or essence of turpentine, in the proportion of, say, nine parts of the former to one of the latter. The liquid is maintained during the operation at the ordinary atmospheric temperature, and when sufficiently saturated with ozone, it can be used as a disinfectant, for washing wounds or sores, etc., etc.—E. G. C.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in the Method of and in Boilers or Apparatus for treating Wood Pulp and other Vegetable Fibre. David Otto, Sweden. Eng. Pat. 11,651, August 26, 1884.

This invention relates to the treatment of wood or other vegetable fibre with solvent—for instance, solution of bisulphite—in boilers for the production of pulp, and consists, firstly, in the application of direct steam to the mixture of fibre and solvent, instead of heating the same by steam pipes; and, secondly, to an improved construction of cylindrical boiler with rounded ends rotating around its greater axis. The outer shell of the boiler is of steel, made in several distinct sections joined together by means of strong enclosing rings of sufficient width to lap far enough upon the two adjacent sections to be firmly secured to these by riveting, brazing, or welding. The inner shell is of lead—which need not be specially pure—about a quarter of an inch in thickness, applied in distinct lengths or sections joined when *in situ* by autogenous soldering. The lining thus formed is quite independent of the steel shell, and is prevented from crushing together by its own weight by means of internal lead-covered bracing, rings made of brass or some other metal having a higher co-efficient of dilatation by heat than iron. Between the lead and steel there is a narrow space; thus the lead can expand and contract without injury; the steel shell affords the requisite strength to the whole structure, the lead alone coming in contact with the contents of the boiler. As air remains in the space between the lead and the steel, and might, at high temperatures, expand sufficiently to crack the lead, a large number of orifices provided with stop-cocks, are made in the steel to serve the double purpose of per-

mitting egress of air and of pointing out the locality of minute cracks in the lead lining, which, if not looked to at once, would give the solution an opportunity to penetrate to the steel, and cause no small damage. Any escape of steam or solution from an orifice indicates damage to the lead in that locality. A sampling cock, of which the surfaces exposed to the solution are of lead, is fitted in a convenient position. Steam is directly introduced by pipes at each end, freely perforated. The extent of highly-heated surface is thus very small, and the inventor considers that it is this which enables him to produce a pulp, by the acid sulphite treatment, containing not more than one per cent. of calcium sulphate, whilst pulp from other boilers contains as much as 10-12 per cent. The solution of bisulphite best of 4·5° or 5° B. with the disintegrated material should not occupy more than two-thirds of the boiler space in starting, as the condensation of steam is considerable. The temperature should not exceed about 150° C., each charge being kept in the boiler rotating slowly for 10 or 15 hours.

—W. D. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Dicinchonine. O. Hesse. Ann. **227**, 153.

The chief source of this alkaloid is the bark of cinchona rosulenta and cinchona succirubra, especially the former, which contains cinchonidine, homocinchonidine, cinchonine, traces of quinamine and conquinamine, and 0·2 to 0·3 per cent. of dicinchonine. The two first alkaloids are precipitated from a neutral solution of the sulphates by means of Rochelle salt; the solution is then saturated with ammonia and shaken with small quantities of ether, whereby cinchonine is for the most part separated. The alkaloids from the ethereal solution are dissolved in dilute acetic acid, and after neutralisation are subjected to fractional precipitation with potassium sulphocyanide. Dicinchonine sulphocyanide is precipitated, but the first and third fractions contain other bases. The salt is mixed with caustic soda and extracted with ether, the extract is washed with water and evaporated, and the residue is dissolved in alcohol and saturated with hydrochloric acid; dicinchonine hydrochloride crystallises from this solution on evaporation. The base is less easily obtained from quinoidine and from cinchona succirubra. The free base, which has the formula $C_{38}H_{44}N_4O_2$, dissolves easily in ether, acetone, alcohol, chloroform and benzene, less easily in water and petroleum-spirit; it is insoluble in caustic soda. Its alcoholic solution is alkaline, and has a bitter taste. It has the rotatory power $(\alpha)_D = +65·6°$. The hydrochloride, $C_{38}H_{44}N_4O_2.2HCl$, forms easily soluble prisms. The chloroplatinate,

$$C_{38}H_4N_4O_2.2PtCl_6H_2 + 4H_2O,$$

occurs in orange flakes; the hydriodide forms compact crystals, readily soluble in water, but insoluble in saturated solutions of common salt or potassium iodide; the sulphocyanide is amorphous; the neutral oxalate is obtained in compact, easily-soluble prisms, when an ethereal solution of oxalic acid is added to an ethereal solution of the base. When heated to 140° to 160° for six hours with concentrated hydrochloric acid, and probably, also, with sulphuric acid diapocinchonine is formed.—S. Y.

Note on Brucine. A. Hanssen. Ber. **17**, 2849.

Brucine was boiled with chromic acid and dilute sulphuric acid. The liquid was poured into hot baryta water, filtered at once, and after removal of the excess of barium with carbon dioxide, the filtrate was evaporated. The acid was set free by dilute sulphuric acid, filtered and evaporated. It solidified to a glassy mass, insoluble in alcohol, chloroform and benzene. It contained no brucine. It was converted into the platinum double chloride, which formed gold-yellow scales. The composition was found by analysis to be $C_{16}H_{20}N_2O_4 + 5H_2O$. A crystalline platinum double salt was also prepared from the product formed by the action of phosphoric chloride on brucine.—S. Y.

The Efficient Matter in Senna-leaves. R. Stockmann. Pharm. J. **3**, 749.

The author repeated Kubly's experiments, thinking that the cathartic acid, $C_{180}H_{96}O_{82}N_2S$, discovered by the latter in senna-leaves, may represent rather a mixture than a uniform body. On preparing the acid, heating the extract or treating it with sulphuretted hydrogen was avoided. After purification, an acid was obtained which contained no trace of nitrogen or sulphur. If the solution of the acid be heated for a few minutes with a dilute mineral acid, it becomes turbid, depositing a brown amorphous precipitate, which has all the properties stated by Kubly for his cathartic acid. But this matter is not of a uniform composition; it can be subdivided by extraction with ether. The filtrate from the brown precipitate contains a sugary matter, which reduces Fehling's solution, but is not able to ferment. Stockmann thinks that cathartic acid belongs to that class of glucosides which can be decomposed by acids into sugar, and a whole series of other products.—S. H.

Quinine Sulphate of Commerce, its Composition and Analysis. W. F. Koppeschaar. Pharm. J. **3**, 809.

Quinine sulphate of commerce contains, besides other alkaloids, nearly always cinchonidine, which cannot be removed by recrystallising. The best method to determine the percentage of quinine and cinchonidine is that recommended by Oudemans—viz., the precipitation of the sulphate solution with sodium tartrate, and after weighing, the polarisation of the tartrates, which contain nothing but quinine and cinchonidine. Whereas the angle of rotation of quinine tartrate is $(\alpha)_D = -215·8°$, that of cinchonidine tartrate is $(\alpha)_D = -131·3°$. The author thinks that the commercial quinine sulphate contains, besides quinine sulphate, a double compound of quinine and cinchonidine sulphate.—S. H.

A New Apparatus for the Preparation of Solid Carbonic Acid. B. Cailletet. Jour. de. Phys. **4**, 122.

The apparatus, which is recommended to replace Thilorier's metal box, is constructed by Ducretet, and consists of an ebonite cylinder, through the lid of which a thin tube conveys liquid carbonic acid up to near the bottom. The carbonic acid which is not condensed escapes through a tube fastened in the bottom, and projecting in the interior of the cylinder for more than half its height. It is preferable to cool the liquid carbonic acid by refrigerating means before allowing it to enter the cylinder.—S. H.

Process for the Preparation of Thallin. Dingl. Polyt. J. **256**, 192.

For the preparation of tetrahydroparaquinanisol, named "Thallin," on account of the fine green colour which this base and its salts develop when treated with oxidising agents, the Badische Anilin- und Soda-Fabrik (Ger. Pat. 30,426, June 18, 1884) proceed as under:—4kilos. of granulated zinc, 15kilos. of hydrochloric acid of 1·14 sp. gr., and 1kilo. of paraquinanisol hydrochloride are allowed to digest upon the water-bath for from eight to ten hours. The reaction is known to be complete when the zinc double salt of the new base, which is soluble with difficulty, begins to separate out. The zinc double salt is purified by recrystallisation from hot water, and the free base obtained therefrom by decomposition with an alkali. Thallin separates in the form of an oil, which solidifies on cooling to a hard, slightly yellow crystalline mass. Thallin is difficultly soluble in cold water, easily soluble in alcohol, ether, petroleum ether, and hot water. It melts at 42-43°, and boils at 282-283° (uncorrected). With organic and inorganic acids it combines to form salts soluble in water, of characteristic properties and crystallising well.—W. D. B.

An Improved Method of Manufacturing Carbonic Acid under any Desired Pressure. F. Raken. From H. Beins and J. F. Beins, Gröningen. Eng. Pat. 4175, April 2, 1885.

Bicarbonate or sesquicarbonate of soda is mixed with ammonium or potassium alum, and water added. By

regulating the amount of this mixture by the capacity of the vessel to receive the carbonic acid liberated, the latter may be obtained under any desired pressure.
—W. D. B.

XXI.—EXPLOSIVES, MATCHES, Etc.

On Nitroglycerine. Mathew Hay. Monit. Scient. 15, 424.

The best proportions for preparing nitroglycerine are 10 parts of glycerine, 30 parts of fuming nitric acid, and 60 parts of strong sulphuric acid, which gives a yield of 234 per cent. on the glycerine. When pure it is a colourless oil, which is not decomposed on heating to 100° C.; 1grm. dissolves in about 800cc. of water, or 4cc. of absolute alcohol. By caustic potash it is not decomposed according to the usually assumed equation :

$$C_3H_5(NO_3)_3 + 3KOH = C_3H_5(OH)_3 + 3KNO_3,$$

but, on the contrary, the glycerine at the moment of its formation is oxidised by the nitrate with production of acetic, formic, and nitrous acids, approximately according to the equation :

$$C_3H_5(NO_3)_3 + 5KOH = KNO_3 + KNO_2 + CHKO_2 + C_2H_3KO_2 + 3H_2O.$$

Other alkalis act in a similar manner.—A. G. G.

Improvements in Explosive Cartridges for Blasting and other Purposes. G. G. M. Hardingham. From Thomas Woolhouse, Paris. Eng. Pat. 2143, January 25, 1884.

"This invention consists of an improved manufacture of cartridges for blasting, mining, and similar purposes, the same being in certain forms adapted for use with ordnance and other firearms. The principle embodied is further applicable to shells, military mines, and other appliances of a like explosive character." A glass vessel containing liquid ammonia is introduced into the interior of a cartridge of dynamite, gunpowder, or other explosive; by the shattering of this vessel at the moment of explosion the ammonia is volatilised, and has the twofold effect of quenching the flame and increasing the effective force. Liquid carbonic acid or other volatile non-inflammable liquid may be substituted for the ammonia. Or an inflammable liquid, as ether, alcohol, or benzoline may be employed. In place of glass, the containing vessel may be made of caoutchouc. Or the explosive may be mixed or saturated with the liquid; thus gun-cotton or tonite may be saturated with ammonia and alcohol. Or the containing vessel may be annular, the explosive being placed within the centre. In cases where it is desirable to dispense with the use of cartridges, the bore hole may be filled with loose powder, with vessels containing the liquid interspersed.—W. D. B.

Improvements in Fuses for Shell Projectiles. Thorsten Nordenfelt. Eng. Pat. 3235, February 13, 1884.

Mechanical improvements, with the object of securing increased safety during carriage over rough roads, etc., and increased stability and efficiency.—W. D. B.

Improvements in Explosive Compounds. Henry Edward Newton. From Alfred Nobel. Eng. Pat. 5382, 1884.

With the object of diminishing the liability to explosion by concussion attendant upon their employment, nitrocellulose, nitro-mannite, nitrated starch, picrates, and other analogous fibrous or pulverulent substances are moistened with a combustible liquid, in which a nitrate or other oxidising agent has been absorbed in quantity sufficient to ensure perfect combustion. Solid combustible material, such as paraffin, stearine, and naphthalene applied in the melted state, may also be employed. Preference is given to the use of glycerine, since when heated it possesses considerable solvent power for various nitrates; the nitro-cellulose or other explosive is saturated with a mixture of glycerine, and the nitrate heated to the lowest temperature requisite for complete solution of the nitrate, and the whole allowed to cool, after which the explosive is ready for use. A good shell composition is stated to be yielded by mixing 1 part of gun-cotton with 2 parts of a solution consisting of equal weights of glycerine, zinc nitrate and cupric nitrate.
—W. D. B.

Improvements in Machinery to be employed in the Manufacture of Lucifer Matches. Thomas Allen, of Reading. Eng. Pat. 5507, March 26, 1884.

This invention consists in an automatic mechanism for the purpose of placing the splints between the laths of the dipping frame, the filling of the dipping frame having hitherto been effected by hand apparatus.—W. D. B.

Improvements in the Manufacture of Gunpowder and other Explosive Compounds by the use of an Improved Material in the said Manufacture. T. Nordenfelt and V. A. Meurling. Eng. Pat. 6515, April 18, 1884.

Cotton or other similar fibre is rendered friable by being subjected to the action of hydrochloric acid, either in the state of gas or in solution, then pulverised and employed in place of the charcoal in gunpowder, or carbonised and the resulting charcoal employed for powder manufacture. Cotton reduced to powder by this means may also be employed in the preparation of gun-cotton.—W. D. B.

Improvements in the Manufacture of Powder for Blasting and other analogous Purposes. Camille Espir. Eng. Pat. 6548, 1884.

The inventor claims the manufacture of a powder for blasting purposes, composed of 66 per cent. of unrefined nitrate of soda; 12 per cent. of refined and triturated sulphur; 22 per cent. of fine sawdust from hard wood. If the compound be intended for artillery purposes, 10 per cent. of charcoal is added. For certain purposes the following composition is adopted:—66 per cent of unrefined nitrate of soda; 8 per cent. of refined and triturated sulphur; 21 per cent of fine sawdust from hard wood; 5 per cent. of charcoal. The sulphur and sawdust are amalgamated by sieving, a solution in boiling water of the sodium nitrate poured upon the mixture, the whole well kneaded and dried by aid of steam.—W. D. B.

Improvements in Detonating Signals for use on Railways and in Apparatus to be employed therewith. E. D. Pass. From C. Lirand and E. Gaupillat, both of Paris. Eng. Pat. 7299, May 6, 1884.

The improvements are confined to the mechanical construction and arrangement.—W. D. B.

Improvements in the Manufacture of Explosives. W. A. Barlow. From Adrien Gaçon, of Paris. Eng. Pat. 9096, June 17, 1884.

In carrying this invention into effect, 69 parts of powdered nitrate of potash are intimately mixed with 19 parts of flowers of sulphur, and 12 parts of ashes, rich in soda or potash, preferably obtained by burning dead leaves. One fifth part of tannin dissolved in 8 parts of water is introduced into the mixture, and the whole allowed to dry. The tannin solution is preferably obtained by making a decoction from chestnut, mangrove or oakwood.—W. D. B.

Improvements in Machines for the Manufacture of Matches. Sydney Pitt. From J. H. Mitchell, of Philadelphia, U.S.A. Eng. Pat. 11,686, August 27, 1884.

The object of this invention is to provide a means for the continuous manufacture of matches, the splints being passed in the machine by a hopper, and the matches finally deposited in drying trays at the other end of the apparatus. By a picking-up mechanism, the splints, of length sufficient for two matches as usual, are delivered from a hopper, into which they are in the first instance

fed, on to an endless band which carries them forward through the machine for a short distance, when their upper surfaces meet a second endless band. The splints are carried between the surfaces of the two bands from this point until just before their final discharge from the machine. By suitable tightening rollers the tension of the belts is so adjusted that they hold the splints securely between them. Before sulphuring, the ends of the splints are warmed by means of steam-heating channels, curved to conform to the travel of the belt, on either side of the machine. The sulphuring is effected by causing the ends of the splints to pass between two asbestos-covered rolls, in contact with one another, suspended freely so as to allow the passage of the splints between them. The lower roll revolves in a pan containing sulphur, the rotation being effected simply by the passage of the splints. The heading apparatus consists of a closed receptacle, containing the composition and a rotating spiral, by means of which the composition is discharged regularly upon a plate which is moved to and from the ends of the splints during their passage over it; this arrangement is adopted to imitate the operation of vertical hand-dipping, and to obtain an equal distribution of the heading composition. The main part of the heading apparatus can be readily detached should the composition take fire. On passing from the heading apparatus, the duplex band is made to take a rapidly reversed serpentine motion by passing around a series of pulleys. The object of this is to give the head a symmetrical form, not attainable if the belt travelled in a horizontal direction, and also to allow the composition to cool and stiffen. The splints are now discharged from the duplex band upon a cutting mechanism consisting of a pair of disc cutters rotating with their edges in contact. The shafts of each disc carry on either side a disc of rubber by which the splint is gripped and prevented from moving sidewise or upward whilst being cut. The now severed matches fall into trays carried upon an endless belt, the trays when filled being removed and laid away for the heads to thoroughly harden.
—W. D. B.

Improvements in the Manufacture of Explosives and in the Treatment of Materials to be employed in the said Manufacture. E. Luck and F. B. W. Roberts. Eng. Pat. 12,292, September 11, 1884.

THIS patent covers two distinct processes, one for refining sodium or potassium nitrate, the other for the preparation of a carbonaceous substance. According to the first, a quantity of plumbic nitrate equivalent to the sodium chloride present in the nitrate is added to the dissolved nitrate, which is then refined as usual. According to the second, wood or a carbohydrate is treated with nitric acid until the whole is reduced to a pasty pulp, the acid neutralised with sodium or potassium hydrate or carbonate, the whole evaporated to dryness, and the product used in the preparation of gunpowder to replace a part of the charcoal. Or the alkaline treatment may precede the application of nitric acid.—W. D. B.

Improvements in the Manufacture of Blasting Powder from Nitrated Cellulose. An Amendment of Specification 13,522, October 13, 1884. See J. Soc. Chem. Ind. iv. 243.

THE claim for the hardening process is now struck out, the claim being now simply "a new method of manufacturing blasting powder, by sawing pieces of strongly pressed nitrated cellulose."—W. D. B.

An Improved Coating for Explosive Compounds and Cartridges. Michael Cock, Victoria. Eng. Pat. 14,361, October 30, 1884.

THE cartridges or explosive compounds which it is desired to coat are warmed and dipped into melted sulphur, either alone or in admixture with other substances —*e.g.*, black lead or iron. The application of this invention is not confined to any particular kind of explosive, nor to the use of pure sulphur, or any particular mixture or compound of sulphur.—W. D. B.

Improvements in Apparatus for Sulphurising and Phosphorising Friction Matches. J. A. Elliot. From Edson Fitch, Quebec, Canada. Eng. Pat. 14,992, November 14, 1884.

THIS invention relates to a continuous apparatus for the manufacture of matches. The splints, in double lengths, are placed promiscuously in a hopper, one side of which can be agitated in order to shake the splints compactly together, thence received between two endless bands running parallel together for a portion of their length between guides provided with adjustable clamps, enabling the bands to hold the splints with sufficient firmness. The splints having been dried by passing over a furnace are ready for sulphurising. To effect this, the belt is canted over by appropriate guides, the splints brought into a vertical position, and their ends dipped alternately in a pan of sulphur kept melted by steam pipes. After sulphurising, the splints are permitted to return to their horizontal position, and brought over the pan containing the phosphorising compound; revolving, bevel-edged wheels transfer the heading composition to the splints, and also bring the ends of the splints in line. The heads are hardened by the application of a cold blast of air, and the splints finally cut in two by a rotary knife.—W. D. B.

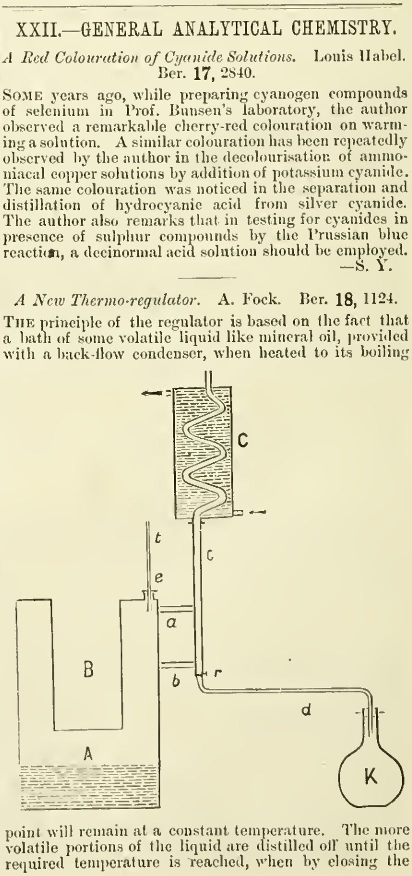
XXII.—GENERAL ANALYTICAL CHEMISTRY.

A Red Colouration of Cyanide Solutions. Louis Habel. Ber. **17**, 2840.

SOME years ago, while preparing cyanogen compounds of selenium in Prof. Bunsen's laboratory, the author observed a remarkable cherry-red colouration on warming a solution. A similar colouration has been repeatedly observed by the author in the decolourisation of ammoniacal copper solutions by addition of potassium cyanide. The same colouration was noticed in the separation and distillation of hydrocyanic acid from silver cyanide. The author also remarks that in testing for cyanides in presence of sulphur compounds by the Prussian blue reaction, a decinormal acid solution should be employed.
—S. Y.

A New Thermo-regulator. A. Fock. Ber. **18**, 1124.

THE principle of the regulator is based on the fact that a bath of some volatile liquid like mineral oil, provided with a back-flow condenser, when heated to its boiling



point will remain at a constant temperature. The more volatile portions of the liquid are distilled off until the required temperature is reached, when by closing the

flow-off tap the condensing worm is brought into action and the liquid is maintained at this temperature without regulating the source of heat. The arrangement as shown in the diagram will be at once apparent. The thermo-regulator is recommended for melting-point determinations, and as the bath is opaque the difficulty occasioned thereby is overcome by adapting an electric signal to indicate the moment of melting, or by providing the bath with a mirror. This apparatus may also be used as an air-bath by closing the inner chamber with a cork.—J. B. C.

Titration of Iron Ores. Walther Hempel. Ber **18**, 1130.

THE analysis of iron ores offers considerable difficulties, since the gangue always contains a considerable quantity of iron insoluble in acid which cannot be determined except by a separate fusion, and the metal is present partly as ferric and partly as ferrous oxide. To obviate this the author proposes the following simple method: The finely-powdered ore (about ·3grm.) is mixed in an agate mortar with pure sodium carbonate (4grm.) and pure calcium carbonate (2grm.), and ignited in an open platinum dish; by this means the iron is completely converted into ferric oxide, which can then be estimated by dissolving the mass in hydrochloric acid and titrating with stannous chloride. All iron ores are readily decomposed by this method.—A. G. G.

A New Reagent for the Absorption of Oxygen. O. Pfordten. Annalen, **225**, 112.

FOR absorbing oxygen the hydrochloric acid solution of chromous chloride is used, made by reducing a solution of chromic acid in hydrochloric acid with zinc and hydrochloric acid, and filtering the solution in an atmosphere of carbonic acid through asbestos, or glass wool, into a solution of sodium acetate. The precipitated chromium acetate is washed and dissolved in hydrochloric acid. Carbonic acid, sulphuretted hydrogen, and other gases which do not act on chromous chloride, can thus be freed from oxygen. The blue solution, as it becomes green by oxidation, can also serve as a sensitive indicator for oxygen. A special apparatus has been devised for this purpose.—S. H.

On a New Method of Estimation of Manganese in Spiegeleisen, Ferromanganese, and the most Important Ores. Wilhelm Kalmann and Alois Smolka. Monatsh. Chem. **6**, 65.

THE author heats 0·15 to 0·3grm. of the finely-powdered substance (it should not contain more than 0·15grm. of manganese) in a platinum crucible, first with a burner, and lastly with the blowpipe, whereby the manganese is converted into mangano-manganic oxide. About twenty times the weight of a mixture of two parts of fused borax, and three parts of sodium and potassium carbonates is fused and powdered, and added to the oxidised substance. The mixture is fused for fifteen or twenty minutes in the closed crucible, and afterwards for five minutes without the cover, the mass being stirred. The contents are then thrown into a measured quantity of a titrated solution of ferrous sulphate acidified with sulphuric acid. The excess of ferrous sulphate is estimated with permanganate. The manganese is calculated thus:—Weight of iron : $x = 10 \times 56 : 6 \times 55$. The author finds that, in the fused mass, for every six atoms of manganese there are 5 atoms of available oxygen. The results by this method differed very little from those obtained gravimetrically. With ferromanganese, rich in manganese, the determinations by the new method may vary 1 per cent. It is most suitable for substances in which the manganese is converted into Mn_3O_4 by simple heating, and which contain at least 1 or 2 per cent. of that metal. The result may be 2 to 3 per cent. too low if the manganese is present as silicate. —S. Y.

Estimation of Titanium in Iron and its Ores. A. Ledebur. Chem. Zeit. **9**, 483.

THE ore to be analysed (2·5grm.) is treated with concentrated HCl evaporated to dryness on the water-bath, the residue heated with a little HCl, diluted with water, filtered and washed with cold water. The residue on the filter is dried, fused with sodium potassium carbonate, the fused mass moistened with water, treated with large excess of HCl and evaporated on the water-bath. To the residue concentrated HCl is added, heated gently for a time, diluted with cold water, filtered and washed with cold water. The two filtrates are united and contain all the titanic acid. It is advisable to test the silica residue by boiling with carbonate of soda solution, in which it should dissolve completely. The titanic acid solution is treated with sufficient sulphuric acid to convert the total chlorides present into sulphates, and evaporate down until all the HCl is given off and the H_2SO_4 begins to fume. The solution is allowed to cool, diluted with water until all the crystallised salts are redissolved, sulphurous acid or $NaHSO_3$ is added, and then gently heated to reduce the iron present. The solution is then neutralised with Na_2CO_3 as far as possible, so that no permanent precipitate forms, and heated in a flask to boiling for two hours. The evaporated water is replaced from time to time, and small quantities of the bisulphite added. The titanic acid precipitates also phosphoric acid and some iron. Filter and wash with water. The precipitate is dried and fused with sodium potassium carbonate and treated with water, whereby the phosphoric acid is dissolved. The residue, consisting of titanic acid and iron, is treated with sulphuric acid, and submitted to the process of boiling and reduction by $NaHSO_3$, as before, to get rid of the iron. To determine titanium in iron 15grm. are dissolved in nitric acid, evaporated and strongly heated to destroy carbon compounds and to drive off HNO_3. The residue is dissolved in concentrated HCl, diluted with water and filtered. The residue on the filter after washing and drying is fused with Na_2CO_3 and KNO_3, the silica separated by evaporating with HCl, and the process continued as above.—J. B. C.

Separation of Zinc from the Group-metals. W. Hampe. Chem. Zeit. **9**, 543.

BY converting zinc, iron, nickel, cobalt, manganese, and aluminium, into formates, and passing H_2S through the solution, ZnS precipitates completely. The precipitate is always free from Mn and Al, and also from Ni, Co and Fe, if the solution contain sufficient quantity of formic acid (at least 15-20cc. acid of 1·2 sp. gr. to 250-500cc. of liquid), and these metals are not present in excess. Fe comes down most readily in such cases, and traces of Ni and Co. In order to eliminate these metals, the filtered and washed precipitate is dissolved in HNO_3, saturated with NH_3, then formic acid added, and the solution reprecipitated with H_2S. In order that the ZnS may be easily filtered, the precipitation is done in a hot solution. The precipitate must be washed with H_2S water, containing formate of ammonia and formic acid. The quantitive tests of the method have been confined to the analysis of zinc blends. The ore is dissolved in nitric acid, saturated with H_2S, the precipitate dissolved in HNO_3, and reprecipitated. The two filtrates are united, saturated with ammonia, formic acid added until the precipitate redissolves, and the hot liquid precipitated with H_2S. The ZnS is then heated in a current of hydrogen, and weighed as metallic zinc.—J. B. C.

Nickel Apparatus for Laboratory use. F. Stolba. Chem. Zeit. **9**, 673.

NICKEL vessels are an excellent substitute for those made of iron or copper. When nickel basins are heated directly by the Bunsen lamp, the colourless flame should be used, as a deposition of soot produces brittleness of the metal. These basins may be used for boiling with caustic alkalis or their carbonates. Crucibles of nickel may be employed for fusing minerals or salts with caustic

or nitrates of the alkalis. Water-baths, spatulas, tongues, etc., of nickel are very serviceable. Nickel is attacked by acids even in dilute solutions, and also by acid salts. It withstands to a remarkable degree the action of strong H_2SO_4. Cerite may be decomposed with concentrated H_2SO_4 in a nickel basin without any injurious effect. Minerals may be treated with fluor-spar and strong sulphuric acid. To what extent hydrofluoric acid affects nickel has not yet been determined. Lead or its oxide do not attack the metal. Platinum vessels, in which substances are to be decomposed by heating with NH_4Cl, may be advantageously replaced by nickel ones. Nickel triangles cannot be recommended, as they become brittle after a time. Nickel tripods and wire gauze are very useful and durable. The apparatus tested by the author was manufactured by Fleitmann, of Iserlohn.

—J. B. C.

On a Reaction of the Aldehydes. Arthur Calm. Ber. **17**, 2938.

The author has examined the action of various amido-compounds on aldehydes, and describes fully the compound formed by the action of equal molecules of benzaldehyde and paramido-dimethylaniline. The substances are mixed either directly or after dilution with alcohol. The product formed is parabenzylidine-amido-dimethylaniline, $(CH_3)_2 - N - C_6H_4 - N = CH - C_6H_5$. It forms light yellow scales or needles melting at 93°. It is but slightly soluble in cold alcohol, but dissolves readily in hot, hence it is easily purified. It is decomposed by strong acids with liberation of benzaldehyde. The hydrochloride, $C_{15}H_{16}N_2 : 2HCl$, was prepared by passing dry hydrochloric acid gas into an ethereal solution of the base.—S. Y.

Characteristic Reaction for Secondary Alcohols. G. Chancel. Compt. Rend. **100**, 601-605.

By the action of nitric acid on the secondary alcohols, dinitro derivatives are formed. Methylbutylcarbinol with an equal volume of nitric acid of sp. gr. 1·35 gives an oil which, when mixed with alcoholic potash, forms a crystalline potassium dinitrobutane. Dinitrobutane gives on reduction normal butyric acid. Methylhexylcarbinol on similar treatment yields dinitrohexane, which forms by reduction normal caproic acid. To detect a secondary alcohol the following method is proposed: 1cc. of the alcohol is treated with nitric acid, the solution poured into water shaken out with ether, and alcoholic potash added. If yellow prisms of the potash salt of the dinitrohydrocarbon form, a secondary alcohol is present.

—J. B. C.

New Books.

A Treatise on Practical Chemistry and Qualitative Inorganic Analysis. Adapted for Use in the Laboratories of Colleges and Schools. By Frank Clowes, D.Sc., London. Professor of Chemistry at the University College, Nottingham. Fourth Edition. London: J. and A. Churchill, 11, New Burlington Street. 1885.

This work, now in its 4th edition, is a small 8vo volume bound in black cloth, with frontispiece representing one of the Laboratory Benches of the University College of Nottingham. This frontispiece is used also in illustration of remarks contained in a chapter on laboratory fittings (Section VII.). Next follows the preface, in which the author states it as his aim throughout to give all necessary directions so fully and simply as to reduce to a minimum the assistance required from a teacher. He also claims to employ language both simple and intelligible, by avoiding the unnecessary use of scientific terms, and by explaining and paraphrasing in ordinary words any such terms when they are introduced for the first time. The table of contents contains references both to paragraphs and pages, and the subject matter is divided into sections instead of chapters. Interspersed in the text are fifty-five wood-cuts, and numerous useful tables. The work terminates with a copious alphabetical index. The general plan and method of the work will be gleaned from the following abstract of the contents :—Section I. The Preparation and Use of Apparatus. Section II. Experiments Illustrating the Preparation and Properties of certain Gases and Liquids. Section III. Analytical Operations, Descriptions Illustrated by Experiments. Section IV. Analytical Reactions, subdivided into *Reactions for Metals* and *Reactions for Acid-Radicals*, *Organic Acid Radicals*. Section V. Analysis of Simple Substances containing one Metal and one Acid-Radical. Section VI. Full Analytical Course and Tables. Reactions and Detection of the Rarer Elements. Reactions of certain Organic Substances. Section VII. Laboratory Fittings, Apparatus, Chemicals and Reagents. A useful List of Apparatus for each Bench-locker is also given on a fly-leaf facing the first page of the text.

Commercial Organic Analysis. A Treatise on the Properties, Proximate Analytical Examinations, and Modes of Assaying the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc., with Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By Alfred H. Allen, F.I.C., F.C.S., Public Analyst for the West Riding of Yorkshire, the Northern Division of Derbyshire, and the Boroughs of Sheffield, Chesterfield, Doncaster, Wakefield, etc. Second Edition, revised and enlarged. Volume I. Introduction, Alcohols, Neutral Alcoholic Derivatives, Sugars, Starch and its Isomers, Vegetable Acids, etc. London: J. and A. Churchill, New Burlington Street. 1885.

Octavo volume, bound in cloth, containing preface, table of contents and 476 pages of subject matter, including an introduction covering two pages, and an alphabetical index covering ten. The work is illustrated with 10 wood engravings, and 1 sheet diagram representing the various starch granules, besides numerous excellent and useful tables. The following abstract of the leading divisions in the table of contents will furnish a correct idea of the subjects treated of in the text, and to some extent of the mode of treatment :—Introduction ; Preliminary Examination of Organic Bodies; Specific Gravity; Observations of Changes of Physical State; Optical Properties; Ultimate or Elementary Analysis ; Behaviour of Organic Bodies with Solvents ; Behaviour of Organic Bodies with Reagents ; Examination for Inorganic Matters. Alcohols : Definition of an Alcohol ; Methyl Alcohol ; Ethyl Alcohol ; Alcoholic or Fermented Liquors ; Amyl Alcohol. Neutral Alcoholic Derivatives : Ether ; Compound Ethers ; Aldehydes ; Chloral ; Chloroform. Sugars : Constitution and Classification of Sugars ; Relations of the Sugars to Polarised Light ; Specific Gravity of Saccharine Solutions ; Action of Strong Acids on Sugars ; Action of Dilute Acids on Sugars ; Inversion ; Fermentation of Sugars ; Action of Alkalis on Sugars ; Reactions of the Sugars as Reducing Agents ; Recognition of the principal kinds of Sugar ; Cane Sugar ; Sucrose ; Malt Sugar ; Maltose ; Milk Sugar ; Lactose ; Glucoses. Starch and its Isomers : Tabular List of Isomers of Starch ; Cellulose ; Starch ; Dextrin ; Gums ; Proximate Analysis of Plants : Composition of Cereals, etc. Acid Derivatives of Alcohols and Vegetable Acids ; Reactions of Vegetable Acids with Reagents ; Acetic Acid ; Homologues of Acetic Acid ; Lactic Acid ; Oxalic Acid ; Succinic Acid ; Malic Acid ; Tartaric Acid ; Citric Acid ; Errata ; Index.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

6276 C. C. Carpenter, Westminster. Improvements in retort-lid fittings. May 22

6466 H. J. Haddan, London—Communicated by J. W. Brightman, United States. Improvements in furnaces. Complete specification. May 27

7035 Machinenfabrik Germania (late J. S. Schwalbe and Sohn, and P. Elfertz), London. Improvements in machines for making ice, and engines wherein cold vapours, air, or gases are employed. June 9

7126 J. G. Lorrain, London. Improvements in chemical precipitation, and in the separation of matter mechanically suspended in liquids. June 11

7399 W. P. Thompson, Liverpool—Communicated by F. C. Glaser, Germany. Improvements in or relating to apparatus applicable for the separation of suspended matters from water or other liquids, and for the removal of the resultant sediment. June 18

II.—FUEL, GAS, AND LIGHT.

6306 G. F. Redfern, London—Communicated by P. Prat, France. Improvements in apparatus for generating gases. May 22

6519 J. Taylor, A. Stewart, and C. Stewart, Glasgow. Burning tar, heavy oils, or other liquid fuels for heating purposes, applicable to steam-boilers and other similar purposes. May 29

6627 R. Wyllie, London. Improvements in the utilisation of the otherwise waste heat from steam-engines, boilers, and furnaces. June 1

6884 J. Y. Johnson, London—Communicated by La Société Anonyme des Forges et Chantiers de la Mediterranée, France. Improvements in machinery or apparatus for manufacturing blocks of artificial fuel. June 5

6931 A. Gontard, Mockau, Saxony. Improvements in the purification of air or gases from solid or gaseous impurities contained therein, and apparatus therefor. June 8

6938 T. S. Lindsay, London. Improvements in the means of generating fixed gases for illuminating, heating, and metallurgical purposes. June 8

7420 E. Entwistle and A. Pilkington, Blackpool. Improvements in apparatus or apparatuses to economise and effect a more efficient consumption of fuel, smoke, and noxious gases in open or closed grates or furnaces. June 18

7457 C. I. C. Bailey and S. C. Dean, Fulham. Improvements in making and utilising water and oil gas. June 18

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

7079 J. Hardman, Manchester. Improvements in and in apparatus for obtaining carbolic acid and other tar acids from tar oils. June 10

7358 A. M. Chambers and T. Smith, London. Improvements in coke ovens and in methods of and apparatus for collecting and utilising the products of combustion from such coke ovens. June 16

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

6218 H. J. Haddan, London—Communicated by E. Frémy, France. Improvements in the treatment of ramie and similar textile fibres, and apparatus therefor. May 21

6333 W. H. Thorpe and G. Pepper, Halifax. Improvements in machinery for drying silk, wool, cotton, and other fibre. May 23

6509 H. H. Lake, London—Communicated by A. Sandron, Belgium. Improvements relating to the waterproofing and preservation of linen and other fabrics, ropes, hose, and other articles composed of vegetable substances. May 28

6593 C. D. Abel, London—Communicated by J. O. Obermaier, Germany. Improvements in apparatus for treating fibres, yarns, and textile fabrics. May 30

6594 C. D. Abel, London—Communicated by J. O. Obermaier, Germany. Improvements in apparatus for treating fibres for spinning. May 30

6846 S. W. Maquay, London—Communicated by G. W. Hamilton, Australia. A wool-cleaning preparation. June 5

6922 W. W. Hamilton, New York. Improvements in treating animal and vegetable fibres for textiles, cordage, and other uses. Complete specification. June 8

6923 W. W. Hamilton, New York. Improvements in treating animal and vegetable fibres for textiles, cordage, and other uses. Complete specification. June 8

7186 W. Jones and C. Kilpatrick, Manchester. Improvements in the treatment of the matters separated or precipitated from the water in which wool, silk, and other fibrous materials have been boiled, scoured, or washed along with soap or other material. June 12

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

6295 and 6296 J. Reffitt, London. Improvements in the means or apparatus employed for dyeing woollen, silk, and other woven or felted fabrics and yarns. May 22

6331 E. Taylor, Manchester. An improved method of purifying and decolouring the water in which silk and other fibrous materials have been boiled along with soap and the refuse, liquid, or dye in which silk and other fibrous materials have been cleansed or dyed, and recovering useful products from such water and refuse, liquid, or dye. May 23

6888 W. R. Lake, London—Communicated by The Prag Smichower Kattun Manufactur and F. Storck, Austria. Improvements in apparatus for use in fixing the colours upon printed cotton fabrics and for washing the same. June 5

7187 J. C. Mewburn, London—Communicated by G. Lombard et Cie., France. Improvements in the means or apparatus employed in purifying, bleaching, dyeing, or otherwise operating upon yarns or threads. June 12

7462 T. Nordenfelt, London. Improvements in the manufacture of blood albumen. June 18

VII.—ACIDS, ALKALIS, AND SALTS.

6127 C. A. Bartsch, London. Improvements in stills for concentrating sulphuric acid. Complete specification. May 19

6131 J. H. Johnson—Communicated by Dr. F. von Heyden, Nachfolger, Germany. A new or improved process for the manufacture of naphthol-carbonic alkaline salts. Complete specification. May 19

6255 W. Black and W. L. Rennoldson, London. An improved process for the manufacture of hydrate of baryta and sulphide of sodium. May 21

6272 G. H. Bolton, Liverpool. Improvements in lids or covers for drums or packages for caustic alkalis or other material. May 22

6404 E. Hanisch and M. Schroeder, London. Obtaining sulphur from furnace gases. Complete specification. May 26

6405 E. Hanisch and M. Schroeder, London. Obtaining liquid anhydrous sulphurous acid from furnace and other gases. Complete specification. May 26

6515 A. Favier, Paris. Producing directly the nitrate of ammonia from the nitrate of soda. May 29

6644 H. Trecht, London. Improvements in obtaining carbonate of potash by the Leblanc process. June 1

6690 T. Terrell, London. Improvements in decomposing sulphate of iron and in the obtaining of sulphurous acid and red oxide of iron thereby. June 2

6715 E. W. Parnell and J. Simpson, Liverpool. Improvements in the extraction of sulphur from alkali-waste and other sulphides of calcium. June 3

6848 L. Pilkington, Liverpool. Improvements in the lids or covers for drums or other packages applicable for caustic alkalis. June 5

6866 T. Twynam, London. Improvements in the production of soluble phosphates of the alkalis in the manufacture of steel and iron. June 5

6867 T. Twynam, London. Improvements in the production of alkaline phosphates in the manufacture of iron or steel from phosphoric pig-iron. June 5

7135 P. Romer, London. Improvements in the manufacture of bichromate of potash. Complete specification. June 11

7136 E. F. Trachsel, London. An improved method or process of producing hydrate or carbonate of strontium or of barium. June 11

7195 J. Mactear, Glasgow. Improvements in the manufacture of the alkaline earths and the hydrates of the same. June 12

7285 R. Oxland and C. Oxland, London. Improvements in apparatus for burning or calcining ores and minerals containing sulphur or arsenic, for the manufacture of sulphuric acid or arsenious acid, or white arsenic. June 15

7317 B. C. Molloy, London. Improvements in the manufacture of sulphuric acid. June 16

7355 H. H. Lake, London—Communicated by A. Kayser, A. B. Young, and H. Williams, United States. An improved method or process for the manufacture of carbonate of soda or soda-ash. Complete specification. June 16

VIII.—GLASS, POTTERY, AND EARTHENWARE.

6163 J. G. Sowerby, London. Improvements in the construction of moulds used in the manufacture of glassware. May 27

6510 J. Y. Johnson, London—Communicated by W. Hirsch, Germany. Improvements in the manufacture of decorated glass. May 28

6739 J. G. Sowerby, London. Improvements in moulds for moulding articles of glass or other ware. June 3

7250 J. Broadhurst, Stoke-on-Trent. An improved pottery kiln or oven. June 15

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

6133 E. Cammiss, London. Improvements in means and apparatus employed in the manufacture of bricks. May 19

6157 C. Schlickeysen, London. Improvements in apparatus for cutting bricks and tiles. May 19

6244 G. E. Smart, Tunbridge Wells. Improvements in tiles

or equivalent, and accessories applicable in the construction of walls or buildings, roofs, pavements, and the like. May 21

6219 G. F. Redfern, London—Communicated by Le Comte Bernard d'Abbadie, France. Improvements in tiles. May 21

6579 J. D. Denny, Newbridge, Ruabon. Double lock tiles for walls, ceilings, partitions, etc.; also box, plates, etc., for making the tiles. Complete specification. May 30

6639 F. Maxwell-Lyte, London. Improvements in the manufacture of refractory bricks, furnaces, converters, crucibles, and other refractory apparatus, and cement. June 1

6813 C. Kingsford, London. Improvements in drying or evaporating apparatus for use in the manufacture or treatment of cement and other materials. June 4

6849 J. D. Denny, Newbridge, Ruabon. An Improvement in making bricks, faced bricks, and ornamented bricks for glazing or otherwise; also in the box-plates, etc., for making the said tiles. June 5

7082 J. F. Ebner, London. Improvements in the composition of adhesive anti-dry-rot waterproof material used, and method of securing parquet flooring to stone, concrete, wood, metal, or other surfaces, applicable to other like purposes. June 10

7106 A. Patrick, Glasgow. Improvements in making sewage pipes, glazed bricks, and other earthenware articles. June 11

7148 C. A. Wilkes and W. Millar, London. An improved metallic compound for flooring, paving, and other purposes. Complete specification. June 11

7189 W. Joy, London. Improvements in the manufacture of cement, and in apparatus for that purpose. June 12

7311 G. M. Garrard, London. Improvements in presses for pressing tiles. June 16

7339 H. R. Snelgrove, London. Improvements in fire-proof ceilings and floors. June 16

X.—METALLURGY, MINING, Etc.

6121 J. R. Griffin, London. Improvements in method of and apparatus for reducing ores. Complete specification. May 19

6138 E. Scott, London. An improved machine or apparatus for washing ore or similar materials. May 19

6190 J. Noad, London. Improvements relating to the extraction of gold and other precious metals from ores and other substances or products containing such metals. May 20

6205 G. Siddell, London. An improved mechanical appliance for working or operating on large forgings in iron or steel. May 20

6211 J. McRobie, Glasgow. Producing steel of highest quality from the commonest pig-iron. May 21

6220 J. G. Laurie, Glasgow. Improvements in and connected with moulds for casting steel or iron or compounds thereof. November 1, 1881.—Previously included in No. 14451 of 1881.

6347 G. M. Edwards, London. Improvements in machinery and appliances for treating, dressing, and cleaning tin and other mineral ores, and in modes, means, and processes connected therewith, and for other useful purposes. May 23

6385 J. Riley, Glasgow. Improvements in admixing ferro-manganese or other substances with steel, and in apparatus therefor. May 26

6129 W. R. Lake, London—Communicated by C. J. Eames, United States. Improvements in the manufacture of iron sponge, iron, and steel, and in apparatus therefor. Complete specification. May 26

6130 W. R. Lake, London—Communicated by C. J. Eames, United States. Improvements in the manufacture of iron sponge, iron, and steel. Complete specification. May 26

6131 W. R. Lake, London—Communicated by C. J. Eames, U.S. Improvements in the manufacture of iron sponge, iron, and steel. Complete specification. May 26

6633 F. Siemens, London. An improvement in the mode of working open hearth iron and steel furnaces, and in the construction of furnaces for that and other purposes. Complete specification. June 1

6638 T. Hampton, London. Improvements in the manufacture of steel armour plates. June 1

6663 J. S. Williams, Riverton, United States. Improvements in the methods of or means for constructing ordnance, and in apparatus or means employed therefor or therewith. June 2

6664 J. S. Williams, Riverton, United States. Improvements in methods or means for moulding or treating metal and other materials, and in apparatus or means employed therein or therewith. June 2.

6671 A. E. Scott, London. An improved process for separating metals from their ores, especially refractory gold ores, mundic, and sulphurous ores. June 2

6711 W. R. Lake, London—Communicated by B. Atha, United States. Improvements in the manufacture of metal ingots and apparatus therefor. June 2

6718 B. D. Healey and B. H. Thwaite, Liverpool. Improvements in the application of gaseous fuel for smelting ores, and in furnace crucible and other plant therefor. June 3

6729 W. P. Thompson, Liverpool—Communicated by A. Kurzwernhart and E. Bertrand, Austria. Improvements in or relating to the casting of iron or steel ingots. June 3

6758 P. M. Justice, London—Communicated by The Frue Vanning Machine Co., United States. Improvements in concentrating or washing apparatus for the treatment of ores or other materials. June 3

6759 J. Deby and H. B. Fulton, London. Metallurgical process for the purification of metals, and for the production of metallic alloys. June 3

6760 H. B. Fulton and J. Deby, London. Improvements in the treatment of copper precipitate, regulus, or ore, for removal therefrom of arsenic. June 3

6873 J. Gjers, London. Improvements in the manufacture of steel. June 5

6893 T. Williamson, Wishaw. Improvements in regenerators and open-hearth furnaces. June 8

6894 J. McCulloch, Glasgow. Improvements in preparing ores, oxides, or compounds of iron for smelting or reducing. June 8

6939 A. Greiner and T. Erpf, Halifax. Improvements in the method of and apparatus for smelting iron. Complete specification. June 8

6970 E. Fischer and J. Posnansky, London. A new or improved process for obtaining white lead direct from the ore. June 8

6991 W. P. Thompson, Liverpool—Communicated by E. H. Cowles and A. H. Cowles, United States. Improvements in smelting ores by an electric current, and in furnaces or apparatus therefor. June 9

7008 E. Heath Oswald and W. R. Oswald, London. An improved method for the more efficient collection and retention of tin and other ores. June 9

7009 T. May, London. Improvements in gas-producing furnaces for smelting metals, glass, brick-burning, and other purposes. June 9

7011 H. J. Allison, London—Communicated by The Compressed Steel Co., United States. Improvements in the manufacture of steel ingots. Complete specification. June 9

7012 H. H. Lake, London—Communicated by H. E. Cahen, called Régnier, France. Improvements in the manufacture of steel. June 9

7071 A. Ephraim, London. A new or improved process for iridising metal objects by electro means. June 10

7093 M. J. E. Morris, London. Improvements in the treatment and concentration of sulphate of iron solution, more especially in the form of tin-plate refuse liquor. June 10

7115 W. Beatson, Rotherham. An improved method of blasting in coal and other mines. June 11

7130 C. H. McEuen, London. An improved process for the extraction of the precious metals from their ores. June 11

7161 E. Hunt, Glasgow—Communicated by M. T. Brown, United States. Improvements in precipitating copper from solutions containing sulphate of copper. June 12

7179 J. H. Johnson, London—Communicated by La Société Anonyme "Le Ferro Nickel", France. Improvements in the manufacture or treatment of iron and steel. June 12

7231 R. G. Brook, Liverpool. New or improved apparatus for blowing molten copper. June 13

7307 A. K. Huntingdon, London. A process for the production of aluminium. June 16

7365 J. E. Stead, Middlesborough. Improvements in the manufacture of iron and steel. June 17

XI.—FATS, OILS, AND SOAP MANUFACTURE.

6270 S. Banner, Liverpool. Improvements in lubricants and in the manufacture thereof. May 22

6495 T. F. Veasey, London. Extracting oils and fat from fish. May 28

6562 C. D. Abel, London—Communicated by L. Hugues, France. Improved apparatus for dissociating neutral fatty bodies by means of heat, and for the direct production of fat acids and glycerine by the action of water at high pressure. May 29

6667 J. H. Ashwell, Liverpool. Improvements in treating or utilising soap suds. June 2

6752 J. Drury, London. Improvements in the method of purifying brown grease. June 3

7154 P. Brintini, London. An improved manufacture of saponaceous material for washing purposes. June 18

XII.—PAINTS, VARNISHES, AND RESINS.

6119 D. McCowan, Glasgow. Improvements in the manufacture of enamel paint. May 19

6811 M. Schumann, London—Communicated by H. Graf, Germany. An improved metallic paint.

7111 G. L. Wigg, M. Steele, and W. J. Wigg, Liverpool. Improvements in the manufacture of pigments. June 11

7121 D. Melville and J. F. Whitney, Liverpool. Improvements in paints, coatings, or compositions for coating ships' bottoms or other submerged structures. June 11

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

7223 P. M. Justice, London—Communicated by A. Sandren, Belgium. Improved means for waterproofing and preserving leather, cardboard, and similar materials. June 13

XIV.—AGRICULTURE, MANURES, Etc.

6153 W. Grimshaw, London. Improvements in treating and drying excreta and manufacturing the same into manure. May 27

XV.—SUGAR, STARCH, GUM, Etc.

6135 J. H. Johnson, London—Communicated by E. M. J. Baptiste, Etienne, France. Improvements in apparatus for the manufacture of loaf sugar. May 19

6139 W. R. Lake, London—Communicated by W. T. Jebb, United States. Improvements in the manufacture of starch. May 19

6140 W. R. Lake, London—Communicated by W. T. Jebb.

Improvements in the manufacture of grape sugar or glucose. May 19

6358 L. Lefranc, London. An improved process of extracting juices, syrups, and molasses in sugar manufactories, refineries, and the like. May 23

6132 W. R. Lake, London—Communicated by F. O. Matthiessen, United States. Improvements in the manufacture of sugar and in apparatus therefor. Complete specification. May 26

6661 A. M. Clark, London—Communicated by the Davenport Glucose Manufacturing Company, United States. Improvements in the manufactore of starch, glucose, and other starch products. Complete specification. June 2

7098 O. Korschelt, London—Communicated by H. Soxhlet, Bavaria. Improvements in the manufacture of grape sugar. June 10

XVI.—BREWING, WINES, SPIRITS, ETC.

6213 J. C. Mewburn, London—Communicated by G. Noback and W. Gintl, Bohemia. Modes of treating and utilising certain waste products obtained in brewing and similar processes. May 21

6288 W. S. Squire, London. Improvements in the manufacture of yeast. May 22

6193 J. Milne, Glasgow. Improvements in apparatus for drying malt, grain, seeds, and other analogous vegetable products. May 28

6801 R. C. Sinclair and J. Hodson, London. Apparatus for effecting the turning of malt or other grain on the drying floors of kilns. Complete specification. June 1

6821 C. Rus Bonne, London. Improvements in apparatus for producing carbonic acid gas, and for utilising the same in raising malt liquors, and for other analogous purposes. Complete specification. June 1

7378 A. G. Salamon, London. Improvement in the treatment of brewers' waste, and in the preparation of compounds to be used for such purpose. June 17

XVII.—FOOD PRESERVING, MEATS, ETC.

6125 C. L. Bachelerie, London. An improved method of rendering incorruptible any organic, vegetable and animal substances, and preserving their nutritious and alimentary properties. May 26

6707 A. W. M. Leicester, London. A process for preserving fruits. June 2

7056 H. T. Johnson, Manchester. The preservation of food by means of air-tight vessels. June 10

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, ETC.

6351 A. Howatson, London. Improvements in apparatus for separating solid impurities from water or other liquids. May 23

6411 A. Breuer, London. Improvements in the manufacture of porous bodies for filtering, or other purposes. May 26

6459 F. R. Conder, Loodon. Improvements in the purification of water, which improvements are also applicable to other sanitary purposes. Complete specification. May 27

6587 W. Macnab, London. Improvements in apparatus for separating liquids from solid matters suspended therein. May 30

6653 T. Bradford, Manchester. Improved disinfecting apparatus. June 2

6853 H. Saunders, Wolverhampton. A vessel to contain certain chemicals, the fumes of which shall neutralise, condense, prevent, or deodorise the evaporation of the effluvia arising from night-soil placed in pans during their removal in waggons through the streets. June 5

6992 M. Hilton, Prestwich. The purification of sewage and sewage waters, bleachers', dyers', and printers' refuse water, and for the recovery, manufacture, and utilisation of products relating thereto. June 9

7230 E. W. Bickerton, London—Communicated by A. E. W. Howe and W. R. Bickerton, Tasmania. An improved preparation for washing or cleansing, and disinfecting purposes. June 13

7278 H. M. Martyn, London. Improvements in the method of and apparatus for disinfecting rags. June 15

7318 G. H. Ellis, London. A new or improved process for the economical production of a porous carbon for filtering, refining, decolourising, and deodorising liquids. Complete specification. June 16

7352 B. L. Ryder, London. Improvements in method and apparatus for desiccating vegetable and animal matter. Complete specification. June 16

7451 R. V. Tuson, London. Improvements in the manufacture of preparations to be used for the destruction of parasites on sheep and other animals, and similar purposes. June 18

XIX.—PAPER, PASTEBOARD, ETC.

6839 R. C. Menzies, C. F. Cross, and E. J. Bevan, Liverpool. Improvements in the preparation of paper pulp from straw, esparto, wood, rags, and like fibrous substances. June 5

6840 R. C. Menzies, C. F. Cross, and E. J. Bevan, Liverpool. Improvements in the treatment of fibrous substances for the manufacture of paper pulp and textile fabrics. June 5

7156 H. H. Lake, London—Communicated by J. Jordan, United States. Improvements in the treatment of paper-pulp, and in apparatus or machinery therefor. Complete specification. June 11

7158 H. H. Lake, London—Communicated by A. D. Beaunier, France. Improvements in the manufacture of cardboard or pasteboard, and apparatus therefor. June 18

XXI.—EXPLOSIVES, MATCHES, ETC.

6182 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles, and in apparatus or means employed therefor or therewith. May 20

6183 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles, and in apparatus or means employed therefor or therewith. May 20

6184 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles, and in apparatus or means employed therefor or therewith.

6185 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles or receivers, and in apparatus or means employed therefor or therewith. May 20

6372 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles or receivers, and in apparatus or means employed therefor or therewith. May 23

6517 W. Kennish, Halifax. Improvements in and relating to explosive projectiles. May 29

6903 T. G. Hart, Dartford, Kent. Improvements in explosives for use in firearms. June 8

6926 H. S. Maxim, London. Improvements relating to the manufacture of explosive compounds. June 8

7215 J. S. Williams, Riverton, United States. Improvements in methods or means of constructing and operating explosive projectiles, and in apparatus or means employed therefor or therewith. June 13

*ENGLISH PATENTS PUBLISHED.**

APPLIED FOR DURING 1884 AND 1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

1884.

8661. E. Morris. Composition for preventing and removing incrustation in steam and other boilers. 2d

9173 G. P. Jaques. Incrustation composition to dissolve the crusts. 2d

1885.

4018 F. W. Gordon. Improvements in hot blast stoves. 6d

II.—FUEL, GAS, AND LIGHT.

1884.

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8810 G. F. Orange. Apparatus for conservating and using the heat produced in furnaces. 6d

13228 B. F. Elderton. The treatment of coal gas, and apparatus for increasing its brilliancy for illuminating purposes. 6d

1885.

3776 A. H. Reed—Communicated by G. E. Moore. The manufacture of hydrogen gas. 4d

IV.—COLOURING MATTERS AND DYES.

1884.

8195 H. J. Haddan—Communicated by the Farbenfabriken vormals F. Bayer & Co. Process for separating the alphamonosulphoacid of the beta-naphthol from certain admixtures. 4d

9518 J. Erskine—Communicated by the Farbenfabriken vormals F. Bayer & Co. The production of colouring matters suitable for dyeing and printing. 4d

9606 W. W. Grieves—Communicated by the Farbenfabriken vormals F. Bayer & Co. Producing yellow colouring matter suitable for dyeiog and printing. 2d

9756 E. Capitaine—Communicated by Ewer and Pick. Producing sulphurous colours. 6d

10100 E. H. Newby—Communicated by E. Thiebaut. The extraction from grapes or raisins of various substances, and the use or application of the same for colouring or other purposes. 4d

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	½d.
Above 8d., and not exceeding 1s. 6d.	1d.
„ 1s. 6d., „ „ 2s. 4d.	1½d.
„ 2s 4d. „ „ 3s. 4d.	2d.

11002 F. Gaess. The manufacture of red azo-dye-stuffs or colouring matters. 4d.

11030 J. H. Johnson—Communicated by H. Caro. The preparation of purple colouring matters suitable for dyeing and printing. 4d

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

1884.

10139 L. A. Groth—Communicated by H. Giesler. Apparatus for, and method of, chemically treating wool, cotton and other soft goods. 6d

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

1884.

9701 D. Dawson. A new method of fixing insoluble azo colours upon cotton and other vegetable fibre. 4d

9802 R. B. Lytle. Bleaching linen and cotton yarns, linen and cotton cloth, and other textile fabrics. 2d

10012 W. D. Thornton. Improvements in the method of and apparatus for dyeing. 6d

VII.—ACIDS, ALKALIS, AND SALTS.

1884.

8803 P. Jensen—Communicated by A. Kux. Apparatus for concentrating sulphuric acid. 6d

9107 E. F. Trachsel. Method of producing carbonate or oxide of strontium or of barium, and recovering bye-products therefrom. 4d

9158 E. Carey and H. Gaskell, jun.—Partly communicated by F. Hurter. Manufacture of sulphite of soda. 6d

9765 J. Imray—Communicated by H. Leplay. Decarbonating carbonate of strontia, and apparatus therefor. 6d

9768 W. L. Wise—Communicated by H. Grouven. Effecting the recovery of sulphur from soda waste. 4d

9997 W. H. Perry and J. O. Boulton. Apparatus for the manufacture of vinegar. 6d

10267 W. A. Hills. The manufacture of precipitated phosphate of alumina and the mixed precipitates of phosphate of alumina and sulphate of lime. 4d

10418 C. T. Richardson. The utilisation of certain waste products from the manufacture of soda and chlorine. 2d

12410 T. W. B. Mumford and R. Moodie. Apparatus for the concentration of sulphuric acid, or for analogous purposes. 6d

1885.

3895 J. J. Hood. The manufacture of chromates and bichromates. 4d

4175 F. J. B. Raken—Communicated by H. Beins and J. F. Beins. Method of manufacturing carbonic acid under any desired pressure. 2d

VIII.—GLASS, POTTERY, AND EARTHENWARE.

1884

10786 C. D. Abel—Communicated by La Compagnie Générale du Verre et du Cristal Trempés. Manufacture of toughened opal glass articles, and apparatus therefor. 6d

1885.

1633 G. W. Wilkinson. Gas kilns for burning glass, china, pottery-ware, and other such like articles. 6d

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

1884.

9357 S. de la Grange Williams and J. A. B. Bennett. Kilns for burning limestone, cement and bricks, and for other like purposes. 6d

9887 H. M. Smith. Coating or surfacing bricks and tiles. 2d

10490 R. Stone. The manufacture of plaster from chalk, lime, gypsum, etc., and machinery and appliances therefor. 2d

1885.

4151 W. E. Heys—Communicated by E. Ladewig. The manufacture of fire and waterproof boards or paper from asbestos. 4d

X.—METALLURGY, MINING, Etc.

1884.

10085 T. Hayley. The treatment and utilisation of the spent pickle after use for cleaning iron. 4d

10620 T. Froggatt. Steeling iron without welding or blistering. 4d

10932 H. H. Lake—Communicated by T. Shaw. An improved alloy, chiefly designed for electrical conductors, and process of manufacturing the same. 4d

15027 F. J. King. The separation of ores and mineral products, and apparatus employed therein. 6d

1885.

479 J. Lletget y Sardà. Improvements in the manufacture or treatment of iron and steel. 2d

1619 A. M. Clark—Communicated by D. Brennan and G. G. Young. Improvements in stone and ore crushers. 8d

1666 J. S. Booth. The construction of boiler and other furnaces. 4d

5003 W. Cochrane. Moulds for cooling and discharging slag. 4d

XI.—FATS, OILS, AND SOAP MANUFACTURE.

1884.

9672 A. Kind. Cooling apparatus for cooling oleine and other liquids. 6d

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

1885.

4921 A. G. Brookes—Communicated by G. H. Maddock. Means or apparatus for brushing and cleaning or treating leather. 4d

XV.—SUGAR, STARCH, GUM, Etc.

1884.

10367 E. Langen. Purifying and clarifying sugar, and apparatus therefor. 6d

XVI.—BREWING, WINES, SPIRITS, Etc.

1884.

10109 W. A. How. Improvements in draught ale and other beverages, and in the means for effecting the same. 6d

10686 A. M. Clark—Communicated by E. L. J. Boniface. Method of converting the juice of the Jerusalem artichoke into levulose, and the application of the latter for obtaining various products by fermentation and distillation. 4d

XVII.—FOOD PRESERVING, MEATS, Etc.

1884.

10495 E. Capitaine—Communicated by R. Habermann. The treatment of the lupinus plant to adapt it for use as food for cattle. 4d

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS, Etc.

1884.

10459 H. Porter and J. H. Porter. Apparatus or means for effecting the softening or purification of water, etc. 6d

10613 H. W. Lee—Communicated by T. Roberts. Method of separating solid and liquid fæcal matters, and appliances for that purpose. 2d

1885.

1580 A. B. Lorenz. Preventing water in reservoirs and pipes becoming stagnant and creating gases or becoming otherwise prejudicial to health. 4d

4016 A. Engle. Destroying and utilising sewage in buildings, towns, and cities. 6d

4207 W. H. Beck—Communicated by H. Wagener and A. Muller. Processes for treating sewage and other waste waters for obtaining the fats, fatty acids, and fibrous matter contained in the same, and in apparatus to be employed therewith. 6d

XIX.—PAPER, PASTEBOARD, Etc.

1884.

11087 J. Jameson. The preparation of safety paper affording protection against erasures or other alterations. 4d

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

1884.

10167 J. G. Johnson—Communicated by F. von Heyden. Manufacture of salicylic acid, and of the homologues thereof. 4d.

XXI.—EXPLOSIVES, MATCHES, Etc.

1884.

15647 C. W. Curtis. Improvements in the manufacture of explosives. 4d

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// THE JOURNAL OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES

No. 7.—Vol. IV. JULY 29, 1885. Non-Members 30/- per annum; Members 21/- per Set; Single Copies 2/6.

NOTICE.

Notice is hereby given that the resolution, embodied in the Report of Council to the Annual General Meeting, 1884, which forbids the publication of communications other than those read before the Society or its Sections, is now rescinded. Communications bearing upon Technical Chemistry can now be sent to the General Secretary, and, if they be approved by the Publication Committee, will be inserted in the Journal.

LIST OF MEMBERS ELECTED, JULY 7th, 1885.

C. A. Bolton, 40, Carlton Street, Nottingham, chemist.
C. D. Clifton, Royal Oak Brewery, Stockport, brewer.
F. C. Coates, Rawson Street, New Basford, Nottingham, pharmacist.
E. Francis, Rock Villas, Parkside, Nottingham, lecturer on chemistry.
F. Goddard, 1, Clipstone Avenue, Nottingham, ironfounder.
Evan R. Harris, Luckwell House, Bedminster, Bristol, iron-works manufacturer.
Adolph Hess, Oil Works, Leeds, chemical manufacturer.
G. F. Horner, Old Basford, Nottingham, bleacher.
G. T. Lewis, 231, South Front Street, Philadelphia, U.S.A. white lead manufacturer.
L. A. Lewis, 12, Crescent Place, Mornington Crescent, N.W., assistant analyst.
Sydney Lupton, M.A., The Harehills, near Leeds.
W. H. Parker, 177, Alfreton Road, Nottingham, pharmacist.
Beatus Petersen, 69, Nyhavn, Copenhagen, manager chemical works.
C. T. Richardson, Monkton Lodge, Jarrow-on-Tyne, alkali manufacturer.
John Thom, Birkacre, Chorley, Lancashire, calico printer.

LIST OF MEMBERS ELECTED JULY 23rd, 1885.

John Abbott, Braemar House, Lancaster Gate, Hyde Park, W., chemical manufacturer.
W. H. Aykroyd, Oakwood Villas, Toller Lane, Manningham, Bradford, dyeing chemist.
Oliphant A. Brown, Lennoxmill, Lennoxtown, N.B., print-works manager.
R. Jeff. Dodd, 195, Queen's Road, Dalston, N., chemist.
J. Emerson Dowson, 3, Great Queen Street, Westminster, S.W., M. Inst. C.E.
Anthony Edge, Readville, Mass., U.S.A., chemist.
E. H. Grimwade, Mildmay Chambers, 82, Bishopsgate Street, E.C., wholesale druggist.
Wm. Hammersley, Tar Works, Beckton, E., tar distiller.
Lieut.-Col. Sir James McGarel Hogg, Bart., K.C.B., M.P., 17, Grosvenor Gardens, London, S.W., chairman Metropolitan Board of Works.
F. Knipler, Starch Works, Wandsworth, S.W., starch manufacturer.
W. W. L. Lishman, 36, Washington Street, Girlington, Bradford, Yorks., dyeing chemist.
V. L. Lovibond, The Hermitage, North End, Fulham, S.W., brewer.
J. G. Flowerdew Lowson, Balthayock, Perthshire, N.B., paper maker.
Wm. Metcalf, Stanhill House, Oswaldtwistle, near Accrington, tar distiller.
Jno. Morrison, P.O. Box 74, North Adams, Mass., U.S.A., colour maker.
Arthur H. Newton, Belsize Court, Hampstead, N.W., colour manufacturer.
Gustav Quaas, Home Park Mills, King's Langley, Herts., paper maker and stainer.
J. S. Rooth, Walton Chemical Works, Chesterfield, manufacturing chemist.

J. Isaac Smith, 1, Norman Villas, Bath Road, Hounslow, sanitary inspector.
G. R. Underwood, Mass. Institute of Technology, Boston, Mass., U.S.A., assistant professor industrial chemistry.
Robt. Warington, Harpenden, Herts., analytical chemist.
Rowland Williams, 9, Albert Square, Manchester, analytical and consulting chemist.
T. Howell Williams, 10, Ascham Street, Kentish Town, N.W., manufacturing chemist.
David W. R. Wilson, Sinderby, Thirsk, Yorkshire, pharmacist.
J. W. Wyatt, Nash Mills, Hemel Hempstead, Herts., civil engineer.

CHANGES OF ADDRESS.

John Barrow (l/o Clayton), Helme House, Sandwich Road, Ellesmere Park, Eccles.
E. T. Brewis, 111, Great Brunswick Street, Dublin.
H. Brown (l/o Cumberland Market), Royal Oak Brewery, Stockport.
G. L. Cabot (l/o Boston), Readville, Mass., until October 31st, then c/o Chas. Almy, junr., Esq., 1, Brewster Place, Cambridge, Mass., U.S.A.
Jno. Cliff (l/o Wellington Street), Nesbitt Hall, Fulneck, Leeds.
H. P. Cooper (l/o Rectory Road), 15, Haringey Road, Hornsey, N.
H. R. Edmands (l/o Brooklyn), 337, East 27th Street, New York, U.S.A.
W. N. Evans (l/o Bristol), 9, St. Bride's Avenue, Fleet Street, E.C.
T. J. Greenway (l/o Wilkinson Street), 378, Ecclesall Road, Sheffield.
T. Farmer Hall (l/o Leatherhead), Dunster House, Mark Lane, E.C.
Ellwood Holmes (l/o Manchester), Wellburn, Jessmond, Newcastle-on-Tyne.
Asa Lees (l/o Fulham), 76, Duncombe Road, Upper Holloway, N.
G. H. Lloyd (l/o Edgbaston), Maney House, Sutton Coldfield, near Birmingham.
A. S. Lodge (l/o Rouen), Spring Side, Prestwich, near Manchester.
John Lyle (l/o Streatham), 37, Mincing Lane, E.C.
F. W. Paul, Hallside Steelworks, Newton, by Glasgow.
W. L. Rennoldson (l/o South Shields), St. Bede Chemical Works, East Jarrow.
F. Rosicki (l/o Manchester), 13, Fasanen Strasse, Frankfort-a-M.
W. Johnston Saint (l/o Munich), 11, Queen's Road, Aberdeen.
Fred. Smith (l/o Chelsea), West Parade, Sutton on Hull.
J. E. Stoddart (l/o Cornwall Street), 60, Robertson Street, Glasgow.
W. S. Squire (l/o Regent's Park), Clarendon House, St. John's Wood Park, N.W.
F. P. Stiker (l/o Oswego), 639, Ellicott Street, Buffalo, N.Y., U.S.A.
Andrew Taylor (l/o South Clerk Street), 11, Lutton Place, Edinburgh.
Sir Chas. Tennant, Bart., M.P., 35, Grosvenor Square, W., and The Glen, Peeblesshire, N.B.
T. E. Vasey, 11, Corn Exchange Chambers, Mark Lane, E.C., and 6, South Parade, Leeds.

Death.

Jas. Higgin, l/o The Hollies, Timperley, Cheshire.

PROCEEDINGS OF THE FOURTH ANNUAL GENERAL MEETING,

Held at the City Guilds of London Central Institute, South Kensington, on Tuesday, July 7th, 1885.

Dr. W. H. Perkin, F.R.S., took the chair at eleven o'clock, and was supported by Mr. E. K. Muspratt (President elect), Mr. Walter Weldon, F.R.S.; Mr. J. C. Stevenson, M.P.; Sir Frederick Abel, C.B., D.C.L., F.R.S., and by representatives of the leading chemical firms throughout the United Kingdom. The minutes of the last Annual Meeting, held in Newcastle-upon-Tyne, were read and confirmed.

The Secretary read the following Report of the Council:—

REPORT OF THE COUNCIL.

Four years have passed since the inaugural meeting of the Society of Chemical Industry, and it is not possible to bring forward a better proof of the success which has attended the Society in its efforts to advance all branches of applied chemistry, than the 2090 names now upon its register. Since the last Annual Meeting at Newcastle, 345 new members have been elected, and 60 have been removed by various causes. The Council has to regret the death of 14 members, of whom the following demand special mention:—Dr. August Voelcker, so well known for his important contributions to the chemistry of agriculture; Sidney Gilchrist Thomas, whose name is identified with the basic process of steel-making; G. W. Wigner, founder and president of the Society of Public Analysts; Dr. Adrian Blaikie, Inspector of Alkali Works for the Tyne District; and Geo. H. Herbert, an enthusiastic supporter of the Society from the outset, and one of the principal merchants of Tyneside.

Two new sections have been established this year—one at Nottingham, under the chairmanship of Professor Clowes; and one for the West of England and South Wales, over which Professor Ramsay, of Bristol, has been elected to preside. The papers and discussions during the past session have reached a total of seventy-one, to which Birmingham has contributed three, Glasgow fifteen, Liverpool six, London seventeen, Manchester thirteen, Newcastle sixteen, and Nottingham one. The Bristol and South Wales Section is only just formed. It has not yet held any meetings.

The Council has felt it desirable that every endeavour should be made to keep the Journal from becoming unnecessarily voluminous, both for the sake of the readers and from motives of economy. A sub-committee has been accordingly formed which has power to reduce shorthand notes of discussions, and it will also be within the province of this sub-committee to induce the authors of papers to make these papers as concise as possible before they are printed in the Journal. In fine, all communications for the Journal will be submitted to this committee in MS.; and in view of this arrangement the Council would, under exceptional circumstances, permit papers other than those read before the Sections, to appear in the Journal under the head of "Communications." In September last five numbers (February to June inclusive) of the first volume were reprinted, at a cost of £128, in response to a generally expressed wish. To this extra expense, and to the general cost of the Journal, must be ascribed a deficit as between receipts and expenditure in 1884 of £167, as will be seen from the Treasurer's report. There will be no reprinting this year; and a substantial increase in the number of members leads the Council to hope that there will be a small surplus.

At the end of last year the Executive Council of the International Inventions Exhibition invited the Society to assist in preparing a representative exhibit showing the progress of applied chemistry during the last quarter of a century. A committee was formed with Mr. Ludwig Mond as honorary secretary, and members were invited to contribute. Twenty-seven responded favourably to the invitation, and a fine collection of chemical products and models, the result of their liberality, now forms the Society's collective exhibit.

Soon afterwards, at the instance of Sir Frederick Abel, the Executive Council of the Exhibition courteously resolved to grant season tickets to the Society's members at half-price, and under the terms of this arrangement 150 season tickets have been sold.

In conclusion, the Council would urge members to use their best endeavours to induce all those who are engaged in industrial chemistry, or whose business involves chemical engineering, to join the Society. The Council places reliance upon the usefulness of the

work already done, and trusts that during the ensuing year the influence of the Society may be extended.

On the motion of Mr. WALTER WELDON, seconded by Mr. E. K. MUSPRATT, it was resolved "That the Report of the Council now read be adopted."

The TREASURER read his Financial Statement for the year ending December 31st, 1884, a copy of which is appended.

SOCIETY OF CHEMICAL INDUSTRY.—TREASURER'S STATEMENT, DECEMBER 31ST, 1884.

Dr.			£ s. d.
To Cash on Deposit (31st December, 1883)		£500 0 0	
Balance at Bank, ditto		423 13 3	
Ditto in Treasurer's hands, ditto		12 12 0	
Ditto in Secretary's hands, ditto		0 11 1	
			936 19 7
Annual Subscriptions:—			
6 for the year 1882		£6 6 0	
95 for the year 1883		99 4 6	
1695 for the year 1884		1,779 15 0	
52 for the year 1885		51 12 0	
1 for the year 1886		1 1 0	
1849 Amounts overpaid		1 17 0	
			1,912 15 6
Life Composition Fees			90 0 0
Interest on Deposit Account			18 11 5
Journal:—			
Advertisements		£182 5 0	
Sales	£361 2 0		
Less Publishers' Commission	53 17 10		
		307 4 2	
			489 9 2
			£3,477 18 8

Cr.			£ s. d.
By Journal Expenses:—			
Publishing		£1,343 19 3	
Editorial		443 10 4	
			1,787 9 7
Reprinting Volume I.			128 0 0
Printing Sundries			125 19 1
Sectional Expenses:—			
Newcastle Section		£23 7 0	
Liverpool Section		27 5 9	
Manchester Section		57 13 8	
Birmingham Section		11 0 2	
Glasgow Section		54 6 8	
London Section		52 8 1	
			226 1 4
Secretary's Salary			200 0 0
Honorarium voted to Secretary for extra work in 1883			25 0 0
Honorarium voted to Edward Hughes for assistance rendered to Hon. Treasurer in 1883			21 0 0
Office Furniture			9 8 0
Office Expenses:—			
Rent		£77 6 3	
Fires, Cleaning, Attendance, etc.		10 1 5	
Gas		0 8 11	
Sundries		1 8 4	
			89 4 11
Stationery			28 15 0
General Postage			8 1 3
Subscription Returned (paid twice)			1 1 0
Bank Charges on Scotch and Irish Cheques, etc.			1 6 0
Secretary's Petty Cash:—			
Carriage of Parcels, etc.		£1 5 6	
Postage, Telegrams, etc.		22 16 9	
Gratuities		1 11 0	
Travelling Expenses (including Expenses of Annual Meeting)		11 18 2	
Stationery		1 3 1	
			38 14 6
Treasurer's Petty Cash:—			
Stationery		£0 12 0	
Carriage of Parcels, etc.		0 6 8	
Postage		11 12 4	
Law Charges		0 6 0	
Fire Insurance Premium		0 2 6	
			12 19 6
Cash on Deposit (31st December, 1884)		£600 0 0	
Balance at Bank, ditto	£176 5 0		
Less Amount owing to Secretary, ditto	1 6 6		
		174 18 6	
			774 18 6
			£3,477 18 8

We have compared the above Statement with the receipts, counterfoils, vouchers and books of the Association, and certify it as correct.

14th February, 1885.

THEOBOLD, BROS. & MIALL, F.C.A.

Messrs. J. ROBBINS, London, and GEORGE WARD, Leeds, were appointed scrutators of the voting papers, which were then handed in, and the President declared the ballot closed.

The PRESIDENT then delivered the following address:—

THE PRESIDENT'S ADDRESS.

Taking a precedent from some of those who have occupied this chair before me, I have selected for my few remarks to-day the subject in relation to Technical Chemistry, with which I have been personally connected—namely, the colouring matters produced from coal-tar products, with some of the lessons its development appears to me to teach us in connection with industrial chemistry. Sir Frederick Abel, in his address in 1883, when speaking of the history of gunpowder, said that "It is one of the most remarkable features connected with the history of gunpowder, that until the last quarter of a century no radical changes should have been introduced into the manufacture and modes of applying this, the first known practically useful explosive agent." It appears to me that this is more or less true of all the older industries, which resulted simply from experiment and observation without any other basis to work from. They have had long histories in which little progress has been made, but of late years, owing to our advanced and rapidly increasing scientific knowledge, they are undergoing great, and in many cases radical changes.

The coal-tar colour industry stands in a very different position to our older ones. It has a sharply-defined origin, and a very short history dating back only to 1856, and it is not yet 29 years since the date of the first patent. It is an industry which has been founded on scientific discovery, and has developed side by side with it, being in fact a most important handmaid to research, which in its turn has repaid it by new discoveries. At the date of its introduction very little was known of the chemistry of colouring matters; they were always found difficult bodies to investigate, and when produced in reactions were generally regarded as secondary products, and every endeavour was made to get rid of them so that the other products associated with them might be examined; but now, owing to the very extended study which has been made of these bodies, on

account of this industry, and the relationships which have been found to exist between the colour of the compounds and the chemical constitution, it is possible with more or less certainty to predict the colour a compound will have before it is produced, and the means which can be used to modify it.

It will be impossible for me to give you but a very brief sketch of the history of this industry in the time at my disposal; anything like a complete account would fill volumes. On account of this I shall not be able to refer except casually to the coal-tar industry itself, the development of which is nearly entirely due to the one under consideration. Nor can I give a consecutive account of the coal-tar colours themselves, because the discovery of new series of colouring matters, and the progress of old ones, necessarily produce overlapping as it were, and renders such a course difficult and confusing. I therefore propose to take them according to the groups we now know them to belong to. I will therefore commence with that which contains the first colouring matter connected with this industry—*i.e.*, the *mauveine* and *safranine* group of compounds.

As I already mentioned, the coal-tar colour industry dates from 1856, the discovery of the aniline purple or mauve dye being made during the Easter vacation of that year, and the patent for its production taken out on the 26th of the following August. From the accounts I have already given elsewhere, I have mentioned how the discovery of this colouring matter was made during the prosecution of scientific research, which had for its object the artificial production of quinine, a subject which of late has very much occupied the attention of chemists, though it has not as yet been accomplished.

When commencing this industry, which was looked upon by many with considerable doubt as to its practicability, the difficulties encountered were very numerous on account of its unique character, but few of the processes having their representatives in other industries, the products were also very valuable, so that great care had to be employed with them. Moreover, the success of the product tinctorially had not been proved on the large scale, so that it was necessary sary to proceed tentatively and not launch out too rapidly.

Aniline, as is well known, was at this period a rare body, originally obtained from indigo by Unverdorben in 1826; for its production from benzene we are first indebted to the discovery of nitrobenzene in 1834 by Mitscherlich, and then to Zinin, who found that this substance when submitted to certain reducing agents produced a base which was eventually identified as aniline. It was not long before the date of this industry that a method of producing this base from nitrobenzene, with greater ease than by the process of Zinin, was discovered; and it is to Béchamp we are indebted for this, who found that the reduction might be easily accomplished by means of iron filings and acetic acid. Had this discovery not been made, aniline could not have been produced sufficiently cheap to be used for the production of colouring matters. And it is interesting to note that this process of Béchamp, slightly modified, is the one used to-day for the production not only of this base, but its homologues and analogous compounds.

It was not long before the difficulties of producing nitrobenzene were to a great extent overcome. Messrs. Simpson, Maule & Nicholson also began to experiment on the production of nitrobenzene, and after a time were able to produce it at a sufficiently low cost to be able to supply us with part of our requirements. I mention this in passing because it was the starting point of the history of the connection of this firm with artificial production of colouring matter, which they carried on so successfully afterwards.

After the mauve was discovered it was necessary to teach dyers how to use it. Being an organic base, it is opposite in properties to the vegetable colouring matter, and therefore the ordinary methods of application were not generally useful, and much time had to be spent in dyehouses and printworks in the early days of this product in reference to this subject, and at that time the question of fastness to light, soap, and bleaching liquor was much insisted on. Fortunately for the future of the coal-tar colour industry, although the mauve would not resist bleaching liquor well, it proved to be a very fast colour—the fastest purple yet produced, I believe—and thus its introduction became rapid. After this the love of brilliancy of colour which it had induced caused less attention to be given to the subject of fastness. I quite think that had this, the first coal-tar colouring matter, yielded colours as fugitive as some which have since been used, this industry would probably have been, to say the least, much delayed in its progress; so that it will be seen the mauve had to bear all the burdens of the difficulties incident on the inauguration of this industry, the future products being free from these impediments. The importance of this colouring matter after its success was established was quickly recognised in France, and its manufacture commenced there. This soon resulted in its importation into this country irrespective of patent rights. As, however, the foreign manufacturer employed responsible agents in this country, the law was without difficulty put into operation successfully—unfortunately, however, only to teach Continental manufacturers the lesson not to employ responsible agents in this country any longer, but, by means of correspondence or travellers to deal directly with the consumers, and this *modus operandi* (practically, though perhaps not theoretically) enabled them to ignore the existence of patents, and import their products freely into this country. On this point I shall have to speak again further on. The mauve was first employed in silk dyeing in London, Messrs. Thomas Keith & Sons, of Bethnal Green, being the first to use it. The second application was calico printing, Messrs. James Black & Co., of Glasgow, being the first to employ it largely for this purpose. It afterwards was extended to other trades.

With reference to the chemical history of this dye, although it had been submitted to analysis very soon after its discovery, its formula, or rather the formula of its principal constituent "mauveine," was not established until some time after it had become a commercial product, and was prepared in a crystalline condition. It was then shown to have the composition $C_{27}H_{24}N_4$ (Proc. R. S. xiii. 170).

It was found to be a very powerful base, decomposing ammonia salts with evolution of ammonia, and combining with carbonic acid to form a carbonate. Its ordinary salts are produced by its combination with one molecule of a mono-basic acid, its hydrochloride having the formula $C_{27}H_{24}N_4HCl$.

In concentrated sulphuric acid mauveine dissolves with a dirty green colour, changing to blue on slight dilution, and back to purple when thoroughly diluted; this is a distinctive reaction of this class of colouring matters. Further researches have shown (*J. Chem. Soc.* xxxv., 717-732) that in the ordinary commercial product, besides mauveine, there are two other compounds, one possessing a redder shade of colour, the other being remarkable for its great solubility in alcohol. This latter from analysis appears to have the formula $C_{24}H_{20}N_4$.

The first product, or mauveine, is evidently a derivative of paratoluidine and aniline. The second of ortho-

toluidine and aniline, and the third of pure aniline. This has been called pseudo-mauveine. It might perhaps be better called pheno-mauveine.

When boiled with aniline mauveine yields an indigo-blue product, difficultly soluble in alcohol. This change takes place without formation of ammonia, and shows how different mauveine is in its character to rosaniline.

Runge found that aniline, when treated with dilute chloride of lime, yielded a blue or violet coloured solution, which soon underwent change. Some experiments on this, made in 1868 (*J. Chem. Soc.* xxii. 25-27), showed that the product which I named "Runge's blue," was a peculiar compound, the salt of an organic base, which itself dissolved in alcohol with a reddish brown colour, the salts being blue. It is quite different from mauveine, and of no practical value; but what is interesting is that when exposed to heat, as by boiling a solution of one of its salts, it decomposes with formation of mauveine.

A beautiful colouring matter was obtained from mauveine by treating it with ethyl iodide. It gives shades of colour of a very red purple tint, and it was therefore called *dahlia*. It was mostly used in calico delaine and other kinds of printing, but being costly, the production was never very large. This substance is a mono-ethyl derivative of mauveine, and all attempts to further ethylate this compound have proved fruitless. In properties it appears to be more like an ammonium compound than a displacement product.

Safranines.

In the preparation of mauveine, a colouring matter was obtained from the liquors, from which it was precipitated, yielding beautiful crimson-red shades of colour on silk. The amount produced in this was so small, however, that we were not able to introduce it as a dye. But it was found that it could be produced by the oxidation of the mauve dye itself, and was then manufactured under the name of "aniline pink," but afterwards "safranine." This substance is evidently closely related to mauveine, as it gives the characteristic reaction with sulphuric acid I have already referred to.

The preparation of this from the mauve dye was too costly to allow of its being brought into general use. However, new processes have been since discovered, by which this or other colouring matters of its class can be produced cheaply.

The first of these processes consisted in passing nitrous acid into commercial aniline, heating the mixture with arsenic acid, and then extracting the colouring matter produced. Hofmann examined this, and showed that it had the formula $C_{21}H_{20}N_4$ (*Ber.* vi. 526, 1872).

The examination of the product which was obtained by oxidising the mauve dye, I found to have the composition, $C_{20}H_{18}N_4$ (*J. Chem. Soc.* xxxv. 731), results which correspond with analyses published by Dale and Schorlemmer (*J. Chem. Soc.* xxxv. 682) obtained from the examination of a similar product. This substance, I also found, was associated with that examined by Hofmann in a product prepared by Messrs. Guinon & Co., of Lyons.

Methods of a more synthetical nature have since then been discovered. O. Witt found that safranine could be obtained from orthoazotoluene and hydrochloride of toluene at 150-200° (*Ber.* 10, 874, 1877). He then found that by oxidising a mixture of one part of paraphenylenediamine, and two parts of aniline, on the application of heat a safranine could be obtained which has the formula, $C_{18}H_{16}N_4$, and which is called phenosafranine.

The formation of this colouring matter by this and other processes has been studied by Nietzki (*Ber.* 16, 464). He finds that the aniline in the reaction, in which paraphenylenediamine takes part, may be substituted by other primary monamines, or a mixture of these with dimethylaniline, and thus a large number of these dyes can be obtained

Phenosafranine is now produced very largely, and in a pure crystallised condition, and is a very useful dyeing agent.

If we assume that all the safranines are strictly homologous compounds, the formula that Nietzki gives for phenosafranine would make the formula of that examined by Hofmann, and that examined by myself and Dale and Schorlemmer, to be incorrect, and that they should contain two hydrogens more than are assigned to them. This I cannot think is possible from all the analytical results we obtained.

The constitution of mauveine has not yet been established, and I have still experiments on this subject in hand. This may also be said of safranine, I think, although Nietzki has proposed a formula for it, in which nitrogen occupies a similar position to the methane-carbon in the rosaniline series.

Triphenylmethane Derivatives.

We must now go back again to the early days of this industry to consider the next class of compounds viz., triphenylmethane derivatives.

The industrial success of the mauve dye caused aniline to become a very favourite body to experiment with, and the result was that in 1859 the discovery of that important colouring matter first known as fuchsine or magenta took place. Hofmann had observed in his experiments on the action of carbon tetrachloride on aniline in 1858, the formation of a red colouring matter, which consisted of this substance as a secondary product of the reaction, but it was M. Verguin who first discovered a process for the transformation of aniline into a red colouring matter of tinctorial value. The discovery of this componnd marks a most important fresh departure in the history of coal-tar colours. As I mentioned, the mauve had paved the way for future colouring matters, and this new substance, which could be applied to fabrics by the same methods as the mauve, was most eagerly sought after owing to the brilliancy of its colour, and probably its manufacture was one of the most successful financially of all the aniline colours.

M. Verguin's process, which consisted in treating commercial aniline with tin tetrachloride, was soon superseded by better processes. The number of patents taken out for the production of this dye was very large, and all imaginable products were claimed as capable of producing it from aniline. The two most important, however, were those in which mercury nitrate and arsenic acid were used. The first of these processes, with which I had some experience, required much care to regulate the reaction and prevent deflagration. The next process with arsenic acid, known as Medlock's, was by far the best, and was employed very extensively until the last few years, the use of nitrobenzene as the oxidising agent being now mostly used in the place of arsenic acid.

The manufacture of magenta, which at this period was often called roseine, was carried on chiefly in this country by Messrs. Simpson, Maule & Nicholson, by the arsenic acid process. Mr. E. C. Nicholson and Dr. A. P. Price, of this firm, worked out the process with great success, and were the first to produce this colouring matter in a pure state. The beautiful display of the crystallised acetate, shown at the Exhibition of 1862, illustrated this fully.

It was with products supplied by Mr. Nicholson that Dr. Hofmann made his first researches on this

colouring matter. He changed its name from roseine to *rosaniline*, and found that the base, when in combination with acids, had the formula $C_{20}H_{19}N_3$.

The important observation of Nicholson, and the critical experiments of Hofmann, on the necessity of using, not pure aniline, but a mixture of aniline and toluidine for the production of this substance, was made about this period.*

The next important step in this industry was the use of rosaniline itself as a source of new colouring matters. For this we are indebted to the experiments of two French chemists—viz., MM. Girard and Delaire, who discovered that rosaniline salts, when heated with aniline, gave violet and blue colouring matters, which they called *Violet Imperial* and *Bleu de Lyon*. It is, however, to Mr. Nicholson that the credit of producing these bodies, in a practically pure state, belongs. This especially refers to the blue, the product known as opal blue, used by Dr. Hofmann in his investigations on the subject, being of great purity. Dr. Hofmann showed that these products were phenylated rosanilines, as is now well known, ammonia being given off in the reaction. And I may mention in passing that the manufacture of these blues is now carried on to such a large extent that the ammonia produced in this reaction is collected for the production of its sulphate or other salt.

One of the difficulties in the way of the new blue was its insolubility in water. Mr. Nicholson, however (in 1862), probably thinking of the method used to render indigo soluble, experimented upon the action of sulphuric acid on this compound, and he found that it was possible to obtain sulphonic acids from it. One of these, the sodium salt of which is known as "Nicholson's" or "alkali blue," is the monosulphonic acid, which is itself insoluble in water, but forms soluble salts, which can be applied to the goods, and then decomposed by acids. This compound has had much to do with the successful introduction of this colouring matter. The other product known as soluble blue is the sodium salt of trisulphonic acid.

In the early part of 1864 the *Hofmann violets* were introduced. These, as is well known, are the ethylated rosanilines produced by acting upon rosaniline with ethyliodide. These colouring matters are more brilliant, though much more fugitive than mauveine; but by this time the desire for permanency was giving way very much to that of brilliancy; and these colouring matters were quickly taken up by dyers and calico printers.

About this time some colouring matters derived from phenol were introduced, and which, curiously, are found to belong to the class of substances now under consideration. These were brought forward by Messrs. Guinon, Marnas & Bonnet, of Lyons. The first product was aurin, prepared from phenol by means of oxalic and sulphuric acid (Kolbe and Schmitt's process). The next was *péonine*, obtained by acting upon aurin with ammonia. The third was *azuline*, prepared by heating aurin with aniline. This last was a blue dye, which has since been shown to consist chiefly of triphenylrosaniline.

Purple and violet derivatives were also obtained from rosaniline by a process of my own, in which brominated turpentine was employed. These were known as *Britannia violets*, and were much used.

Other coloured derivatives were also discovered; for example, by the action of aldehyde and sulphuric acid, a blue product was obtained, which, when treated with sodium hyposulphite or sulphuretted hydrogen water, yielded the well-known *aldehyde green*.

On examining the action of acetylchloride on Britannia violet, I obtained a peculiar green, which was used principally by calico printers, and very considerable quantities of acetylchloride were prepared for this purpose. The process was not published. This green was of a blue shade, and was obtained in a crystallised condition in combination with picric acid. The crystals had a golden metallic reflection.

Soon after this it was noticed that a green compound was produced in the preparation of the Hofmann violets, though generally only in small quantities. It was afterwards found that by making rosaniline react with an excess of methyl iodide that it could be produced practically. It was called *iodine green*; but the product now manufactured is a chloride. This colouring matter gave good candlelight greens. One of its peculiarities is that when heated it is converted into violet methyl-rosaniline, with loss of methyl-chloride.

A new method of producing rosaniline violet was proposed by Lauth, and patented by MM. Porrier and Chappat, in June, 1866. The process consisted in taking aniline, in which hydrogen had been replaced by an alcohol radical, and oxidising this instead of first preparing rosaniline, and then replacing the hydrogen in the colouring matter by the radical. The product proposed for this purpose was methylaniline.

Owing to the improved method of methylating aniline, which, I believe, was first proposed by Messrs. Girard and Delaire (*Bull. Chem. Soc.* [2], vii. 360), this process has become a very important one, and large quantities of dimethyl-aniline are now used, the oxidation being effected by copper salts. The product, according to the researches of Otto Fischer, consists chiefly of pentamethylpararosaniline.

The most important advance in the production of green colouring matters of the triphenyl-methane series was the discovery of the *Benzaldehyde*, *Victoria or Malachite green*.

In 1877, Otto Fischer, whilst investigating the condensation products of tertiary aromatic bases (*Ber.* x. 1625), obtained by the action of benzaldehyde on dimethyl-aniline in presence of chloride of zinc, a colourless base of the formula $C_{23}H_{26}N_2$, the salts of which, when exposed to the air, rapidly oxidised to a fine blue-green dyestuff, which, he thought, would prove to be of complicated constitution. A little later (*Ber.* xi. 950) he showed that by treating this colourless base with some of the ordinary oxidising agents, this green could be more easily produced, and that it stood to the colourless compound in the same way as rosaniline does to leucaniline. Emil and Otto Fischer afterwards say (*Ber.* xii. 796) that the first experiments for the production of this green were made by the Badische Anilin- und Soda-Fabrik, in March, 1878. About this time Oscar Doebner (*Ber.* xi. 950) found that a green colouring matter was produced by heating benzaldehyde with benzyl trichloride and zinc chloride. This product has been found to be identical with that of Fischer's. This green colouring matter is now largely made from benzaldehyde, as this process is found to be the best. A similar compound is also prepared from diethylaniline, and is known as brilliant green. It is a beautifully crystalline body. It is rather curious that this produces shades of colour somewhat yellower than the green from dimethyl-aniline, whereas, being of a higher molecular weight, we should have expected it to be bluer.

The principal difficulty which had to be contended with in the production of these colouring matters was the need of a supply of benzaldehyde. The usual

* In my original patent it was shown that colouring matters could be obtained, not only from aniline, but also from toluidine, xylidine and cumidine—these bases, as usually prepared at that date from the hydrocarbons obtained by fractioning coal-tar naphtha, not being pure, but mixtures.

method of obtaining it from bitter almonds, which was the only one in use, was quite out of the question, so that other sources had to be looked for. The Badische Anilin- und Soda-Fabrik, however, successfully overcame this difficulty. At first they experimented with the process of Lauth and Grimaux, which consists in the oxidation of benzyl-chloride, with an aqueous solution of lead nitrate; the product made by this process, however, was too dear. But they found that the decomposition of benzylidene-dichloride, by means of water, as observed by Cahours (*Ann. Chem. Suppl.* 2, 306) and Limpricht (*Ann. Chem.* 139, 316) gave them a means of producing this compound practically, the reaction being as follows :—

$$C_6H_5CHCl_2 + OH_2 = C_6H_5.CHO + 2HCl.$$

This process, which they have successfully employed since March, 1878, consists in the preparation of benzylidene dichloride from pure toluene, and in the subsequent treatment of this chlorinated body with milk of lime, at 100° C.

I have stated that the group of colouring matters under consideration are called triphenylmethane derivatives, and to show how this has been proved to be the case, I must now refer very briefly to some of the theoretical work which has led to this knowledge. The most important of this refers to rosaniline. I have already drawn attention to the work of Hofmann, which gave us the first knowledge of the composition of this colouring matter, and the further information that it contained hydrogen, which could be displaced by phenyl and alcohol radicals; but as to the matter of constitution, I think the experiments of Caro and Wanklyn were the first, as they showed the relation which existed between rosaniline and aurine, or rosolic acid, and, in fact, they produced rosolic acid from rosaniline; but it is to the beautiful researches of Emil and Otto Fischer that we are indebted for a clear knowledge of the constitution of this class of colouring matter.

But to clear the ground before proceeding further, I must remind you that ordinary commercial rosaniline, or magenta, prepared from aniline and toluidines, is a mixture of colouring matters. This was first known by Mr. Nicholson, who found that for the production of the finest blues it was necessary to purify the base and separate one of these before phenylating; but it is only of later years that the difference between these bodies has been carefully studied and explained. The base examined by Hofmann contained C_{20}, and is the chief constituent of commercial rosaniline. The other contains C_{19}, and is now called pararosaniline, because it is produced from aniline and paratoluidine. Similarly, in commercial aurin, two compounds are found, one containing C_{20}, now called rosolic acid, and one containing C_{19}, now called aurin; and these latter can be produced from the corresponding rosanilines; and Dale and Schorlemmer have also shown that aurin can be also converted into pararosaniline, by the action of ammonia (*J. Chem. Soc.* xxxii. 121).

Emil and Otto Fischer, however, by submitting the leuco compound of commercial rosaniline to the diazo reaction, obtained the hydrocarbon $C_{20}H_{18}$, and from rosaniline prepared from paratoluidine and aniline the hydrocarbon $C_{19}H_{16}$.

And this latter hydrocarbon was found to be identical with Kekule's triphenylmethane—

$$\begin{array}{l}C_6H_5\\C_6H_5\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_5\\H\end{array}$$

On nitrating this hydrocarbon, they obtained a trinitro derivative, which, when reduced, gave the tri-amido body,

$$\begin{array}{l}NH_2C_6H_4\\NH_2C_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH_2\\H\end{array}$$

which is paraleucaniline, and by carefully heating its hydrochloride to 150-160°, it was converted into pararosaniline.

Also they found that by oxidising trinitrotriphenylmethane they obtained trinitrotriphenylcarbinol, and this when reduced gave pararosaniline direct.

From these results the constitution of the base is evidently—

$$\begin{array}{l}NH_2C_6H_4\\NH_2C_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH_2\\OH\end{array}$$

Pararosaniline.

The salts—the hydrochloride, for example—being

$$\begin{array}{l}NH_2C_6H_4\\NH_2C_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH.HCl\\ \rule{2em}{0.4pt}\end{array}$$

Pararosanilinehydrochloride.

Similar results were obtained from the hydrocarbon from rosaniline; it is tolyldiphenylmethane :—

$$\begin{array}{l}C_6H_4(CH_3)\\C_6H_5\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_5\\H\end{array}$$

The rosolic acid and aurin corresponding to the rosanilines are constituted in an analogous manner :—

$$\begin{array}{l}HOC_6H_4\\HOC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4O\\ \rule{2em}{0.4pt}\end{array} \quad \text{and} \quad \begin{array}{l}\left.\begin{array}{l}HO\\CH_3\end{array}\right\}C_6H_3\\HOC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4O\\ \rule{2em}{0.4pt}\end{array}$$

Aurin. Rosolic acid.

From these results we see the beautiful relationships of the various colouring matters of this series to each other, and by it obtain information which is of practical value, as well as theoretical. The following formulæ of a few of these products further illustrate this :—

Methane (Marsh Gas) $\begin{array}{l}H\\H\end{array}\!\!>C<\!\!\begin{array}{l}H\\H\end{array}$

Triphenylmethane $\begin{array}{l}C_6H_5\\C_6H_5\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_5\\H\end{array}$

Leucopararosaniline $\begin{array}{l}H_2NC_6H_4\\H_2NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH_2\\H\end{array}$

Pararosaniline $\begin{array}{l}H_2NC_6H_4\\H_2NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH_2\\OH\end{array}$

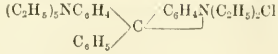
Pararosaniline hydrochloride $\begin{array}{l}H_2NC_6H_4\\H_2NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4NH.HCl\\ \rule{2em}{0.4pt}\end{array}$

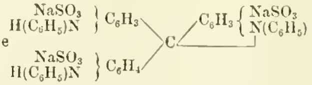
Triphenylpararosaniline hydrochloride (Aniline Blue) $\begin{array}{l}H(C_6H_5)NC_6H_4\\H(C_6H_5)NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4N(C_6H_5)HCl\\ \rule{2em}{0.4pt}\end{array}$

Hexamethylpararosaniline (Methyl Violet) $\begin{array}{l}(CH_3)_2NC_6H_4\\(CH_3)_2NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4N(CH_3)_2Cl\\ \rule{2em}{0.4pt}\end{array}$

Methyl Green $\begin{array}{l}(CH_3)_2NC_6H_4\\Cl(CH_3)_3NC_6H_4\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4N(CH_3)_2Cl\\ \rule{2em}{0.4pt}\end{array}$

Benzaldehyde or Victoria Green $\begin{array}{l}(CH_3)_2NC_6H_4\\C_6H_5\end{array}\!\!>C<\!\!\begin{array}{l}C_6H_4N(CH_3)_2Cl\\ \rule{2em}{0.4pt}\end{array}$

Brilliant Green 

Soluble Blue 

The effect of displacing hydrogen by hydrocarbon radicals in rosaniline is seen to result in the shade of colour becoming bluer for each hydrogen displaced—the effect of those of high molecular weight, such as phenyl, being to produce the greatest change; thus triphenylrosaniline is blue, whilst hexamethylrosaniline is blue-violet, notwithstanding it contains six hydrogens displaced.

After all the displacements possible have been effected, as in hexamethylrosaniline, the result of the combination of the products with halogen compounds of methyl is very interesting. The particular group to which this is attached becomes of the nature of an ammonium, and the colour does not become bluer, but changes to green—*i.e.*, methyl green,—and this, like other ammonium compounds, when heated, dissociates, with loss of the halogen compound of methyl, and then hexamethylrosaniline is reproduced. Again, if this ammonium group be substituted by phenyl, we also get a green product—*i.e.*, Victoria green.

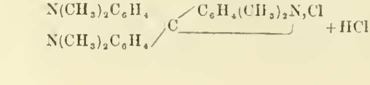
The structure of some of these bodies has been proved by another most beautiful synthetical process, which has lately come into use—a process which enables us now not only to say that we employ the volatile products of the distillation of coal, but also the coke itself; as carbonic oxide in combination with chlorine, phosgene or carbon oxychloride, is one of the important agents used. This substance was discovered in 1812 by J. Davy.

In 1876, W. Michler gave an account of his researches on the synthesis of aromatic ketones by means of phosgene (*Ber.* ix. 716), in which he showed by the action of this substance on dimethylaniline that a tetramethylated diamidobenzophenone was obtained. This substance has, therefore, the constitution—

$$N(CH_3)_2C_6H_4-CO-C_6H_4(CH_3)_2N.$$

The formation of this product takes place in two phases, but I need not enter into that now.

The first experiments to turn Michler's synthetically prepared tetramethylated diamidobenzophenone to practical account were made by Dr. A. Kern, in the works of Bindschedler, at Basle. Dr. Kern proved that an agent like phosgene might be produced on a larger scale, and he invented a process to convert Michler's ketone base into methyl purple. This process was derived from the ketone synthesis of triphenylmethane from benzhydrol and benzene, and consisted in preparing the tetramethyldiamidobenzhydrol, and condensing the latter with dimethylaniline; thus the leuco base of hexamethylrosaniline was obtained, and then oxidised with lead peroxide. This process, which was too costly for practical purposes, has been superseded by one discovered by Dr. Caro, who has found that this ketone base can be made to form condensation products with dimethylaniline and other products directly, by the use of phosphorous trichloride—this substance converting it first into a chloride, which then reacts on the dimethylaniline, thus—



And this reaction takes place quantitatively, the body being so pure that it readily crystallises from water in prisms, like potassium permanganate, only with a very much more brilliant lustre. These contain water of crystallisation. The condensation can also be effected with phosgene gas. The colouring matter obtained by this means is bluer than that obtained from dimethylaniline by oxidation, which consists chiefly of the pentamethyl compound.*

Diethylene can also be made into a ketone with phosgene or carbon oxychloride, and this product condensed with diethylaniline yields hexaethylpararosaniline.

Instead of dimethylaniline, dimethyl-α-naphthylamine can be used, and in this case a beautiful blue colouring matter is obtained, and if α-phenylnaphthylamine be employed, the *Victoria blue* is produced, and by varying the reaction in this kind of way a great variety of colouring matter can be synthetically prepared.

With ammonias this ketone condenses to form the new yellow colouring matter, *auramine*, with aniline *phenylauramine*. With quinoline it produces a green very similar to Victoria or benzaldehyde green. I must not however spend any more time over this interesting part of the subject, but may say here again we have pure scientific research conducted for its own sake, bearing fruit. The discovery of W. Michler, which remained for seven years a matter of theoretical interest, now comes forward as a matter of practical value.

Anthraquinone Series.

I must now draw your attention to the important class of colouring matter compounds obtained from anthracene or anthraquinone.

Alizarin and the other colouring matters related to it form one of the most important branches of the coal-tar colour industry, and is one of special interest, because alizarin was the first instance of the production of a natural colouring matter artificially. It will be quite unnecessary for me here to say much about the madder root, which was the original source of alizarin, and was grown in such enormous quantities, but now is nearly a thing of the past; nor will I enter into the early chemical history of alizarin, and all the laborious work which was bestowed upon it by Dr. Schunck and others. As you are probably all aware, the relationship of alizarin and its formation from the coal-tar hydrocarbon anthracene was the result of the labours of Graebe and Liebermann, the researches which culminated in this being of a purely scientific nature. The original process for obtaining it has, however, not been found of practical value, but a new one in which sulphuric acid could be used in place of bromine was afterwards discovered by Caro, Graebe and Liebermann in Germany, and by myself in this country, apparently simultaneously. A second process was also discovered by me which was worked nearly all the time I was engaged in this industry. In this dichloranthracene was used instead of anthraquinone, and the product thus obtained yielded colours of a brilliancy which it has been found, even to the present time, difficult to match by the anthraquinone process.

At the time of the discovery of artificial alizarin, anthracene was not prepared by the tar distillers, as it had no application, and very little was known about it. It was discovered in 1832 by Dumas and Laurent. In 1854-55, when studying under Dr.

* See Patents, Caro, 4128, September, 1883; 1850, March 13, 1884; and 5038, March 18, 1884.

Hofmann, I worked with it for some time, but my results were never published, because, owing to the erroneous formula given for it by Dumas and Laurent, which was accepted, my results would not fit in; nevertheless the information obtained afterwards proved of great value to me, although at the time the labour spent appeared to be lost labour, showing the value of research even when not successful. The formula of this hydrocarbon was not established until 1862, when it was studied by Dr. Anderson. This was only six years before the discovery of Graebe and Liebermann, and, had not the formula of anthracene been established before these chemists commenced their work, the relationship of alizarin to it would not have been discovered, and up to this day it is possible that this artificial alizarin industry would not have been in existence. Researches like that of Dr. Anderson I have often heard spoken of slightingly, because they don't bear much on their surface; but who knows what such work may lead to? Earnest workers cannot be too much encouraged.

As anthracene was not a commercial product, it was necessary to experiment on its production before alizarin could be manufactured, and not only on the best methods of getting it, but also to get a rough idea of how much could be produced, because unless the hydrocarbon could be obtained in large quantities, artificial alizarin could not compete with madder. In our works at Greenford Green we commenced by distilling pitch; but afterwards tar distillers were induced to try to separate it from the last runnings of their stills by cooling and then filtering off the crystalline products which separated out, and in fact visits were paid to most of the tar distillers of the United Kingdom, others being corresponded with on the subject, and the result was that in a short time such quantities came in that the distillation of pitch was abandoned. And although much doubt and anxiety prevailed at first as to the possibility of getting a sufficient supply of this raw material two or three years since, there were about 1000 tons of commercial anthracene (about 30 per cent.) produced in excess of the requirements, the annual production in the United Kingdom being estimated at about 6000 tons 30 per cent., or nearly 2000 tons pure anthracene.

Although the colouring matter obtained from anthraquinone or dichloranthracene was at first simply considered as alizarin more or less pure, yet on investigating the matter it was soon found that it contained other colouring matter. To this I drew attention in 1870 (*J. Chem. Soc.* xxiii. 143, footnote), and in 1872 gave the analysis of a product which I named anthrapurpurin, followed by a more extended account a year afterwards (*J. Chem. Soc.* xxv. 659, and xxvi. 425). This was called anthrapurpurin; because it is an anthracene derivative having the formula of purpurin, with which it is isomeric. In the latter paper I also referred to another colouring matter dyeing alumina mordants of an orange colour (*J. Chem. Soc.* xxvi. 425). It was also shown that anthrafluoric acid when fused with alkali gave a colouring matter behaving with mordants in the same way (*J. Chem. Soc.* xxvi. 20), and this has proved to be the same body. This latter reaction was afterwards more fully studied by Schunck and Roemer, and the colouring matter produced by it was shown also to have the formula of purpurin; they therefore called it flavopurpurin (*Ber.* ix. 678), so that the colouring matters formed have proved to be three in number—alizarin, anthrapurpurin, and flavopurpurin, all of which are valuable dyes, whereas in madder root there is only alizarin and purpurin, the latter being of but secondary value. This can now also be produced from anthracene. The researches which have been made on the subject of the conditions under which these different colouring matters are formed, have led to the discovery of methods for their separate production, so that in artificial alizarin, which name commercially embraces all these colouring matters, both mixed and separate, we have more than a simple replacer of madder root, and as these colouring matters just referred to can be applied with the same mordants, varieties of styles of work can be produced by the calico printer and dyer which before were unknown. Anthrapurpurin is, I believe, of as great importance as alizarin itself, and used with it increases its brilliancy, and alone gives very brilliant scarlet shades.

Artificial alizarin was first produced commercially in this country by my firm at Greenford Green in 1869, when 1 ton was produced; in 1870, 40 tons were made, in 1871, 220 tons, and so on increasingly. It was not produced on the Continent until 1871, when, according to Graebe and Liebermann, 125-150 tons were made. These weights do not apply to dry colour, but to paste.

I cannot go into any lengthened account of the chemistry of this industry here; its development, however, has kept pace with theoretical investigations, in some cases it may be said to have forestalled it. For example, in the old methods of working, more anthrapurpurin than alizarin was produced; the conditions required to modify this were found out by experiment. According to all our previous knowledge as to the introduction of hydroxyl into a body by the fusion of its sulphonic acid with alkali, a monosulphonic acid should give a monohydroxyl compound, and a disulphonic acid a dihydroxyl compound. Therefore to produce alizarin, which is a dihydroxyl compound, an anthraquinone disulphonic acid was thought to be the proper thing to use. By experience this was gradually found to be incorrect, a monosulphonic acid being required to produce alizarin, a disulphonic giving anthra or flavopurpurin, the colouring matter not being due to the primary but to a secondary reaction, as was afterwards shown by research—the mono and dioxyanthraquinones (the latter known as anthraflavic and isoanthraflavic acids) being the first products of the reaction, and then undergoing oxidation by the caustic alkali employed, yielding the corresponding colouring matter, a portion of the products, however, being at the same time reduced back to anthraquinone.

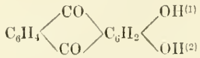
A very important improvement preventing this loss by reduction was discovered by J. J. Koch, who found it might be avoided by the use of a small quantity of potassium chlorate with the alkali used in the fusion.

The amount of caustic soda used in this industry is very large, and at the Badische Anilin- und Soda-Fabrik,—and, I believe, elsewhere—it is made on the spot; and I must say the cleanly way in which alkali is made in the above works contrasts very favourably with what I have seen in some of the alkali works in this country.

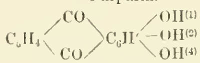
Like rosaniline, alizarin has now become a material for preparing other colouring matters. Of these there are two in use—viz., nitroalizarin, which gives orange-yellow shades with alumina mordants, and alizarin blue, a remarkable compound prepared from nitroalizarin by treating it with sulphuric acid and glycerol. This gives shades of colour like indigo. When first discovered, considerable difficulty was found in its application on account of its insolubility; it has since been found to form a soluble compound with sodium bisulphite, and by this means its application has become much easier. The constitution of

the colouring matter derived from anthracene may be represented as follows :—

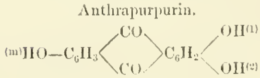
Alizarin



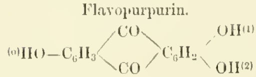
Purpurin.



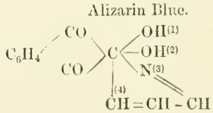
Anthrapurpurin.



Flavopurpurin.



Alizarin Blue.



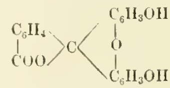
Those colouring matters under the name of artificial alizarin are the most important of the coal-tar colours, their money value amounting to more than a third of the entire value of all the colours produced in this industry, and at present the price of artificial alizarin compared tinctorially is not more than one-fourth of that which madder or garancine ordinarily were before their production. There are now three works producing it in this country, but the bulk of that used still comes from Germany.

Phthalines.

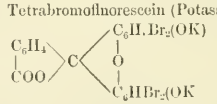
The discovery of this class of bodies dates back to 1871, and was the result of the investigation of Baeyer. He found that phenols unite with a number of polybasic acids and with aldehydes, with separation of water when the mixture is heated alone, or with glycerol and sulphuric acid, the compounds formed not being ethers. Those produced when phthalic anhydride is employed, and which embrace those of practical value, are called phthalines. The first of these discovered by Baeyer was *galleïn* (*Ber.* iv. 457), produced by heating pyrogallol with phthalic anhydride ; its formula is $C_{20}H_{14}O_5$; by reduction it loses the elements of water and combines with hydrogen forming *cœruleïn.* These colouring matters, which for a long time remained unnoticed, are now being extensively used.

Later, in 1871, Baeyer discovered *resophthalin*, or *fluorescein* (*Ber.* iv. 555). This substance, which is remarkable for its yellowish green fluorescence, dyes silk and wool yellow, but does not combine with mordants, and is not a very useful dyeing agent. But it was discovered by Caro in 1874, the subject being afterwards worked out jointly with Baeyer, that fluorescein when brominated yielded that beautiful dyestuff now called *eosine* ; this was introduced into the market in July, 1874. Other substitution products were then studied, and the iodine product was found to give bluer shades of red than the bromine. One of the most beautiful colours of this series is the dichlortetraiodofluorescein, in the preparation of which dichlorphthalic anhydride is used. It is called *phloxine.* The methylic ether of eosine and its nitro derivative also have become commercial articles. These bodies are now manufactured in a practically pure condition. Their structure has been made out by research to be as follows :—

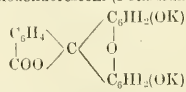
Fluorescein



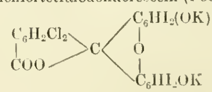
Eosine. Tetrabromofluorescein (Potassium Salt).



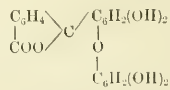
Tetraiodofluorescein (Potassium Salt).



Phloxine. Dichlortetraiodofluorescein (Potassium Salt).



Gallein



The introduction of these colouring matters had a great influence on the manufacture of phthalic acid. This acid, it will be remembered, was proposed a good many years since as a source for the production of benzoic acid, which was largely in demand for the manufacture of aniline blues, phthalic acid when carefully treated with lime yielding calcium benzoic. But as phthalic acid was required to be produced in an extensive way, new experiments had to be made on the subject. The difficulties connected with this were surmounted by the Badische Anilin- und Soda-Fabrik, who are now the chief manufacturers of this body and its anhydride, which is the substance required ; when freshly prepared it is one of the most beautiful products one can see.

Dichlorophthalic acid is now also manufactured for the preparation of the bluish shades of fluorescein derivatives already referred to. But this is not all ; it was not only necessary to produce this anhydride in quantity, but it was necessary also to produce *resorcinol.* This substance was originally prepared from galbanum by fusing it with potash, or by distilling brazilin, etc., both technically impractical processes. It was afterwards produced by fusing various halogen derivatives of phenol and benzene sulphonic acid with alkali ; these also were not practical processes. It was, however, eventually found that it could be produced by fusing metabenzenedisulphonic acid with potash, the original observation being made by Gallik ; and by this process this product, which was a rare compound, is now manufactured and has become a common one, being produced in very large quantities.

Indigo Series.

Indigo is too well known a substance for me to make any remarks in reference to its history as a colouring matter, and with reference to the chemical side of the question I suppose few substances have

had more work bestowed upon them than this body, so that I must confine any few remarks to its artificial formation. There is one point of interest, however, connected with indigo, and that is that it was the original source of aniline, this base being discovered in the products of its destructive distillation by Unverdorben, in 1826, as already mentioned.

Notwithstanding the large amount of work which has been bestowed upon this colouring matter, its constitution has only been lately arrived at, and for this, and the methods of its artificial formation, we are indebted to the beautiful and laborious researches of Baeyer. The first process for its artificial production was patented by Baeyer in March, 1880. The process consists in preparing orthonitropropiolic acid and acting upon it in presence of an alkali, with a reducing agent, such as grape sugar, xanthate of sodium, etc.

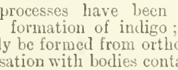
$$2[C_9H_5(NO_2)O_2]+H_4=2CO_2+C_{16}H_{10}N_2O_2+2H_2O.$$

This process renders the application of artificial alizarin very easy to calico printing, because the products can be applied to the fabric and the reaction then completed, and thus the indigo is formed and fixed in the fibre, and this process is in use in some of the printworks of Mulhouse, where there is a continued though small demand for orthonitropropiolic acid. Other processes have been discovered by Baeyer for the formation of indigo; he has found that it can easily be formed from orthonitrobenzaldehyde by condensation with bodies containing CH_3CO group, such as acetone.

Hitherto this artificial formation of indigo has not met with much practical success. This does not arise from difficulties in its manufacture, but in its cost compared with natural indigo, which is a very cheap dyestuff.

So far as it has been manufactured, however, the possibility of this has been entirely dependent upon scientific research disconnected with its study. To prepare nitropropiolic acid it is necessary to begin with cinnamic acid as a raw material. This acid, until 1877, was only obtained from certain balsams, and was a very costly material. It was then discovered that it could be produced with comparative ease by the action of acetic anhydride and an acetate on benzaldehyde (*Journ. Chem. Soc.* xxxi. 428). Caro afterwards found that this process might be simplified by heating a mixture of benzylidene dichloride with sodium acetate, and it is by this process that it is now prepared.

The constitution of indigo Baeyer represents as follows:—



Several derivatives have been made which are interesting dyes, such as methyl indigo, tetrachlor indigo, etc.

Azo Compounds.

The commencement of the history of the azo colours in an industrial sense has little to do with the theoretical side of the question, the early products being the offspring of empirical observations, and in no way connected with the theory of the diazo compounds, a condition of things very different from that now existing. Time will not allow me to enter into the beautiful work of Griess, much of which will be found in the "Philosophical Transactions" for 1864.

The first definite compound of this class, shown to possess dyeing powers, was a substance discovered by Prof. Church and myself, known first as nitrosonaphthalene, then as azodinaphthyldiamine, but now called amidoazonaphthalene. This substance, however, was of no practical value, because its salts, which are violet, cannot exist except in the presence of a certain amount of free acid. This substance has since been found of value in the preparation of the Magdala Red.

The first substance of this class sent into the market was the phenylic analogue of amidoazonaphthalene—viz., amidoazobenzene, which was discovered by Mène. It was introduced by Nicholson, who prepared it by a process which has not been published. It was afterwards patented by Dale and Caro, in 1863. This is a yellow dye, but did not demand success, because of its volatility. It has, however, since become useful for the manufacture of induline.

The first really successful azo colour was Manchester or Bismarck brown (triamidoazobenzene), which is produced by the action of nitrous acid on metadiamidobenzene.

The next important step took place in 1876, by the discovery of chrysoidine, by Caro and Witt. Independently, this product is prepared by the action of diazobenzene on metadiamidobenzene.

About this time the subject began to be worked out on a scientific basis, and since then the number of diazo dyes produced is marvellous, and it will be useless for me to do more than to refer to one or two of the most important. About this period also the value of the sulpho group began to be realised, and this has greatly added to the value of these dyes.

The first use of the sulpho group in relation to azo colours was in connection with amidoazonaphthalene, patented by myself in 1863.

During the early history of the coal-tar colours, innumerable experiments were made with naphthalene derivatives to produce colouring matters, but no results of any value were obtained; the experiments were mostly made with naphthylamine. The first colouring matter that was obtained from it that was of value was Martius' yellow a dinitronaphthol. After this came the Magdala red, which was not much used. The principal development of the coal-tar colours of late years has, however, been in connection with diazo reaction. In these reactions naphthol is much used, and this product, which a few years ago was unknown, is now manufactured by tons by fusing naphthalene sulphonic acid with alkali, and is produced at a few pence per pound. Most of the azo colours produced from benzene derivatives are of a yellow or brown colour, but, by taken products of a higher molecular weight, colours of different shades of red are produced. The one which has commanded the greatest success is the scarlet, first known as Meister's scarlet, produced by the action of diazoxylene chloride on the disulphonic acid of β-naphthol; its constitution may be represented thus:—

$$C_6H_3(CH_3)_2-N_2-C_{10}H_4(OH)(HSO_3)_2.$$

And in the formation of bluer shades, diazocumene chloride is used. The cumidine used is now made from xylidene, by the beautiful reaction of Hofmann's, in which an alcohol radical associated with the nitrogen leaves that element, and enters into the hydrocarbon radical. These scarlets have had a very injurious influence on the cochineal market, and have in many cases displaced cochineal.

If α-diazonaphthalene chloride be used instead of the xylene or cumene compounds, the colours known as Bordeaux is produced. Then, again, where derivatives of α-naphthol are used, different results are also obtained, so that great varieties of products can be produced. The preparation of these azo colours is a matter of much simplicity, the colouring matter being precipitated in bringing the products together, and, moreover, they can be produced in almost theoretical quantities; hence they are remarkably

cheap dyeing agents. The following are the formulæ of some of these azo dyes :—

Bismarck Brown. $NH_2C_6H_4.\overset{(m)}{N_2}.C_6H_3(NH_2)_2HCl.$

Chrysoidine. $C_6H_5.N_2.C_6\overset{(m)}{H_3}(NH_2)_2HCl.$

Fast Yellow. $KSO_3.C_6H_4.N_2.C_6H_4NH_2.$

Manchester Yellow. $\underset{(4)}{\overset{(3)}{NaSO_3}}.\underset{(1)}{\overset{(1)}{C_6H_4}}.N_2.C_6H_4NHC_6H_5.$

Orange. $NaSO_3.C_6H_4.N_2.C_{10}H_6\overset{\beta}{(OH)}.$

Fast Red. $NaSO_3.C_{10}H_6.N_2.C_{10}H_6\overset{\beta}{(OH)}.$

Ponceau G. $C_6H_5.N_2.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}.$

Ponceau 2R. $(CH_3)_2C_6H_5.N_2.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}$

Bordeau. $\overset{\alpha}{C_{10}H_7}.-N_2.C_{10}H_4OH\overset{\beta}{(NaSO_3)_2}.$

From which it will be seen that the colour changes from yellow to red and claret by the increase of the molecular weight of the radicals introduced, and also by the relative position occupied by the groups, etc.

Quinoline Compounds.

Products of the quinoline series have of late been claiming attention in relation to colouring matters. It will perhaps be remembered that, in the early days of the coal-tar colour industry, a beautiful blue colour belonging to this series, discovered by Greville Williams (*Chem. News*, Oct. 11, 1860, 219), was introduced. This substance was called cyanine. Its employment as a dye for silk at first produced quite a sensation, on account of the beauty of the colour; but unfortunately it was too fugitive to be of any practical value. Recent researches have shown that chrysaniline is also to be regarded as a body of the chinoline class. Alizarin blue, and also the beautiful yellow dye obtained from acetanilide by Fischer, and known as flavanilin, are found also to belong to this class of substances.

Other colouring matters which have since been prepared from quinoline direct might be referred to did time permit. The peculiar green which is produced by the condensation of tetramethyldiphenylkëtone with quinoline is of interest, because the introduction of this quinoline has a very different influence on the resulting colouring matter to that of groups containing amidogen—in fact, it appears to act more like phenyl, as the green is very analogous to benzaldehyde green.

There is a very interesting new manufacture growing out of the coal-tar colour industry, and that is, the preparation of derivatives of quinoline as substitutes for quinine. I have mentioned that much work has of late been directed to the study of quinine itself, and although the artificial formation of this substance has not yet been discovered, new bodies have been obtained during these investigations which are thought to possess valuable medical properties. This is rather a remarkable development from this industry, seeing that it was owing to experiments made on the artificial formation of quinine that it owes its foundation.

There is another peculiar colouring matter I have not yet referred to—peculiar, as it contains sulphur. I refer to methylene blue, a very valuable dye, the constitution of which has been so well worked out by Bernthsen. I feel I must be content with this slight reference to it.

As I have shown, the coal-tar colour industry originated in this country, where for some time it was solely carried on. The second impulse was from France in the discovery of magenta and its blue and purple phenyl derivatives, which were soon brought to a state of great purity in this country. The Hofmann violets were then discovered and produced also in this country, several other colours being perfected and largely used. By this time the manufacture of coal-tar colouring matter had made some progress in Germany and Switzerland; crude products in a cheap form were first made, but improvements soon followed. The subject of these colouring matters was taken up with great earnestness in the German laboratories so much so that it was stated at one time that this industry was acting injuriously to science, as it had diverted an undue amount of attention from other subjects. Time has, however, proved the groundlessness of this statement. This laboratory work, as well as research work generally, fitted a number of highly-trained chemists to enter the colour works, where they soon improved the processes, and thus they were able to produce products of a quality to compete with those of English manufacture, which had, owing to their purity, given superior and more reliable shades of colour in the hands of the dyer; and the result of the application of this scientific labour to this industry is that Germany produces products of the highest class and at the lowest price. The fact that Germany is now the head-quarters of this industry, raises the important question, Why has England allowed this state of things to come about? All the raw materials are produced in this country, both the products from coal and the other chemicals required, and, as we have seen, the industry originated and was first carried on here, and, in addition, we are the greatest consumers of the colouring matters. This fact is well worth considering, and it is many-sided. In my opinion, the Patent Laws, and the difficulty of preventing infringements from abroad, was one cause which may have prevented this country from maintaining its first position.

When speaking of the early history of the first coal-tar colour mauveine, I referred to this class of infringement and how it was first met by the proceedings taken against the agents employed in this country, and that this course was so far successful, but only pointed out how easily the law could be evaded if foreign manufacturers gave up responsible agents and sold direct to the consumers. Having no duties on such articles, no assistance could be obtained at the Customs, and the colouring matters were generally declared under the name of vegetable dyes or extracts, so that it was impossible to stop them entering the country, and even when found, owing to the onus of proof of their being manufactured by the patentee's process laying with the patentee, an almost insurmountable difficulty was raised, as in most cases no traces of the products used in the preparation were left in the colouring matter. The only other proceedings which could be instituted were against the consumer; here again the difficulties were practically insuperable.

In most cases the consumers were using the patentee's products to some extent, and it was impossible to know to what extent, in fact, without going into the many details connected with this point, it may be assumed that in most cases proceeding against a consumer of this kind of article is detrimental and practically useless.

The result of this infringment, by importation from abroad, is that a patentee had to compete against all other manufacturers with the exception of *his own countrymen.*

There can be but little doubt that this state of things has had much to do with preventing the development of this industry, and crippling enterprise in this country, as it prevented manufacturers even from working under royalties, there being no security whatever except in name. Again, the fact that a

foreigner could take a patent in this country, manufacture in his own country, and send the product here, was a great source of loss and mischief to our trade. The new patent laws may probably alter this, but still the difficulty of importation in defiance of patent rights still remains.

There is another matter which tells much against this country—namely, that we are not able to export colour to foreign countries upon the same conditions as foreign manufacturers can into this, because we are met with import duties which handicap us to a prohibitive extent, whereas the foreign manufacturer, being protected in his own country, may maintain his prices there and sell at a lower price in this country; but what is still more injurious, he may dispose of surplus production in this country at or even below cost price. The injurious effect of such a course upon our market can be easily understood by business men, and I need not go into it here. These are matters our manufacturers have to contend with, and cannot help themselves; there is, however, one matter in which they are undoubtedly at fault.

We find that in Germany the manufacturer understands the value of well-trained chemists, and sympathises with them; they also realise the value of theoretical chemistry—this is a condition of things we don't find in this country.

Unless I am mistaken, the coal-tar colour industry has acted as the great stimulus to the development of general chemical industries of Germany, and these, by starting with so much scientific aid as they have called to their assistance, have made an amount of progress during the last 25 years which is most remarkable. Up to that time England had been the seat of most of the large chemical industries, and the success which we have had appears to me to have produced a feeling of false security, and more attention has been paid by the heads of firms to the markets than to the chemistry of their manufactures.

I believe that 30 years ago there were very few chemists employed in chemical works, either in this country or on the Continent. Now there are very few without them; but in this country they are far less numerous and much less efficient than in Germany, and for this our manufacturers are to a great extent responsible. I am told that at some of our large chemical centres, the chemists, or so-called chemists, are sometimes paid not more than could be earned by a bricklayer. If such openings are put by manufacturers before young men, their parents are not likely to give them an expensive scientific training. If they get any they are not likely to continue it longer than enough to do analysis very imperfectly, say by studying for about nine months. An ordinary tradesman would not be considered efficient unless he passed a much larger apprenticeship than this, but I know teachers complain that it is difficult to get students who are to be works chemists to stay longer than this. The result is that when really efficient men are wanted, they are not to be found, and they have to be got from abroad. In my address to the Chemical Society last year, I referred to the past neglect of research at our chemical schools, so that I need not speak further on that aspect of the subject here, though it is an important one in relation to our industries.

There is no chasm, as we have already seen, between pure and applied chemistry, they do not even stand side by side, but are linked together, so that a technical chemist needs to be a thorough chemist, and unless we employ such men we must be at a great disadvantage in relation to foreign manufacturers.

This brings me to a subject which has occupied much attention of late, but I fear is much misunderstood by the public generally. I refer to the teaching required by technical men, or technical education. The general idea is that it should be carried out in what may be called its narrow sense. That is to say, that it should be in relation to the existing manufactures and the present methods employed in them. Whereas there can be no doubt it will be of small service unless it is carried out on a very broad and scientific basis. As it is, the processes which are *publicly* known and taught, are more or less antiquated, simply because improvements are naturally kept secret as long as possible, and therefore to spend a large amount of time in studying details of old processes would manifestly be a great waste of power, and I am glad to find that this view of the matter is held by some of our leading chemical manufacturers. Our chemical industries are now undergoing such rapid and radical changes, owing to the advances in scientific discovery, that this cannot be too much borne in mind. To train a young man as a technical chemist, I consider, requires first that he should have a thorough knowledge of chemical science and know how to use it by conducting research, that he should have a general knowledge of those sciences which are connected with it, such as physics, and of those subjects required by all manufacturers, such as engineering mechanics, etc., and also study the way chemical operations are carried out on the large scale, not in one branch of manufacture only, but in many.

With men in our works so trained, and of course possessing the suitable natural qualifications, we might expect to see our chemical industries make good progress and keep well to the front, but such a course of study could not be gone through in twelve months, nor would men so qualified be content to receive the remuneration for their services which is now given.

The proposed course for technical chemists at the Central Institute of the City and Guilds of London Institute is to occupy three years; the students having already devoted one year to elementary chemistry, this makes four years of study, and this is hardly sufficient. It is to be hoped that those who are to be principals, or to take responsible positions in works, will avail themselves of the opportunities afforded by this Institute or get some similar course elsewhere, so that we may have efficient men in this country to advance our chemical industries, and also that the value of such chemists may be appreciated in this country.

The employment of well-trained chemists in Germany, and the division of labour which results from this, has no doubt been one of the chief causes of the great success not only in the colour, but in other chemical industries. In this country it not unfrequently happens that an inventor, or the head of a firm, feels that no one can do the work he is connected with like himself, which is probably quite true, but at the same time he forgets that one person is not able to attend to the details of a number of processes adequately from sheer want of time and strength; if, however, properly qualified men can be set over them, although they may be slower and less capable than himself, yet having less divided minds and more time they are able to work out the details under his direction with much more success than he could alone, as well as see things from other points of view, and thus greater perfection will be attained. I think this is a matter deserving of careful attention on the part of our manufacturers.

I have now given a very brief, and therefore a very imperfect outline of the history of the coal-tar colour industry, an industry to which none other can be compared for its rapid progress. I have drawn your attention to the fact that it is the offspring of scientific research, that in return, as I before stated, it has

in many cases given a fresh impulse to research by giving the chemist new products, and also by opening up new subjects of theoretical interest for consideration, and from the fruits thus resulting again reaping further benefit. This linking together of industrial and theoretical chemistry has undoubtedly been the great cause of its wonderful development. We now have not only all the colours of the rainbow, but we have also the more sombre, but often not less useful, colours, and, moreover, there are also great varieties of products of similar colour possessing different properties which fit them for special uses. This industry is also one of no mean dimensions. I have not been able to get any very recent statistical information on this subject, but notwithstanding the great reduction of prices of the products of late years, yet owing to the extended development it has undergone, the value of the annual output has probably increased and not declined, and from what information I have on the subject I should say it is perhaps not less than £3,500,000.

In my remarks I have also been led to refer to some of the points connected with the migration of this industry from this country to Germany, and the probable influence our patent laws had upon this, to the matter of technical education, and the employment of high-class chemists in chemical works. This latter subject is undoubtedly of great importance, and requires the earnest consideration of our manufacturers. If it is found profitable to employ chemists of this class on the Continent, surely it should be found equally profitable to employ them here. In conclusion, I am happy to say there are signs of the coal-tar colour industry returning to our country, in part at any rate, especially in relation to alizarin, for which there are now three large works in existence, and the production of other colouring matters is also increasing.

Mr. J. C. Stevenson, M.P., in proposing a vote of thanks, said that they were fortunate in having a president who had all along been identified with the very important industry, the progress of which had just been described. Having himself given his attention to the more simple department of inorganic chemistry, he admitted his incompetence to fully appreciate, much less criticise, the amount of research thus laid bare, but at any rate he could admire the facility with which the president manipulated the complex formulæ of the substances described. Nothing could more clearly illustrate, on the one hand, chemical science in its marvellous interconnection with chemical industry and, on the other hand, the important position which in the future these new industries must take in their Society. Coal tar, once adjudged little better than a refuse and only fit for daubing palings, now appeared as the source of a host of beautiful colours — colours so bright as to shock that modern æstheticism which demanded to be clothed in the hues of faded leaves. But even these were doubtless well within the powers of their president to produce. At Avignon there was a monument to the man who benefited his countrymen by the introduction of the madder root as a staple industry in the Department. What a memento was this monument of a vanished industry displaced by the process which the President had described. At the same time, they must remember that chemistry was not as yet independent of organic materials for these colours—the product of the vegetable life of the primæval forests. Whether chemistry would ever make coke and water into sugar was problematical, but at all events, up to the present, it had only succeeded in extracting and developing from organic bodies principles already existent in those bodies. He was glad to note that these modern chemical industries were still in some sort dependent on their older brethren for reagents, and that they still required caustic soda and hydrochloric acid. On these older industries the remarks of the president had a bearing, though in them there might not be so much scope for science as there was in the special branch chosen by the president; nevertheless, he was free to confess that in the past too much reliance had been placed on our natural advantages of cheap fuel and machinery, and too little upon science. Manufactories might be more orderly, and the British workman had yet to learn the value of tidiness. He moved that a hearty vote of thanks be given to the President for his most able address.

Mr. E. K. Muspratt, in seconding the motion, was glad to hear Dr. Perkin state that the removal of the aniline industries to Germany was due, in his opinion, to two causes—(1) The effect of our patent law, and (2) the want of technical education in this country. He himself mainly ascribed it to the second cause, but in a somewhat wider sense; and so far as patents were concerned, the evils arose not from any defect in the law of patents, but from the absence of a uniform and international patent law. Technical schools were of undoubted value, but if children were not well educated in primary and intermediate schools they would never grow up to be successful competitors with the Germans. Long before technical schools were established the German universities afforded scientific education in abundance, and one of the reasons why they had been so successful in applying science to their industries was that many of them were educated as purely scientific chemists. We ought not to lose sight of this fact, but should train our rising generation to think and investigate for themselves, thus becoming efficient chemists rather than mere testing machines.

Mr. Walter Weldon, F.R.S., asked Mr. Stevenson to somewhat enlarge the scope of his motion so as to convey to Dr. Perkin a vote of thanks not only for his address but also for his great services as President. During the past session some ten or twelve council meetings and twenty or thirty committee meetings had been held, and Dr. Perkin had attended all those meetings, and had given the most careful attention to every item of business which had come before them. In fact he had torn himself away from his beloved research to attend to the business of the Society as devotedly as a merchant in the City attends to the business by which he gains his livelihood.

Mr. Stevenson then put the motion in the amended form, which was carried unanimously.

The President then briefly replied.

The scrutineers then presented their report on the results of the voting for ordinary members of Council, as follows:—

The scrutineers reported that they examined 205 ballot lists, of which five were invalid. The result of their examination of the valid votes given shows that the following have been elected ordinary members of Council:—

R. Forbes Carpenter.	Dr. S. A. Sadler.
Henry Doulton.	Sir Bernhardt Samuelson, Bart., M.P.
Dr. John Evans, F.R.S.	Sir Charles Tennant, Bart., M.P.
Ivan Levinstein.	Prof. W. A. Tilden, F.R.S.
Dr. R. Messel.	John Williams.
B. E. R. Newlands.	
Thos. Royle.	

(Signed) J. ROBBINS.
GEO. WARD.

The President declared the above duly elected, together with the following:—

President: Mr. E. K. Muspratt.

Vice-Presidents:

Sir F. A. Abel, C.B., D.C.L., F.R.S.	David Gamble.
Sir J. Lowthian Bell, Bart., F.R.S.	Dr. Peter Griess, F.R.S.
Alexander M. Chance.	Dr. W. H. Perkin, F.R.S.
Prof. James Dewar, F.R.S.	John Spiller.
James Duncan.	E. C. C. Stanford.
	J. C. Stevenson, M.P.
	Walter Weldon, F.R.S.

Treasurer: E. Rider Cook.

Foreign Secretary: Ludwig Mond.

Mr. David Howard proposed the reappointment of Messrs. Theobold Brothers as auditors, saying the complexity of the accounts was so great that it was desirable that professional auditors should be appointed.

Mr. William Crowder seconded the motion, which was carried unanimously.

NEXT PLACE OF MEETING.

Mr. Muspratt proposed that the next Annual Meeting be held at Liverpool, which he might describe, with Widnes, as being the birthplace of the Society. On behalf of the Section, he could assure the members that they would have a cordial welcome.

Dr. Hewitt seconded the motion, which was carried unanimously.

Mr. Muspratt then took the chair.

Mr. F. Siemens' paper was then read.

ON HEATING REGENERATIVE GAS FURNACES BY RADIATION FROM FLAME, AND ON PRODUCERS TO SUPPLY GAS SPECIALLY SUITABLE FOR THAT PURPOSE, AND FOR THE RECOVERY OF BYE-PRODUCTS.

BY MR. FREDERICK SIEMENS.

In tracing the action within a flame from the moment the gases unite until the heat has been fully abstracted from the products of combustion, the flame will be found to pass through various successive periods materially differing from one another; of these there are two which require quite different development and treatment. The first is the period of active combustion, the essentially chemical process by which the heat is produced. The second period is after combustion has been completed, when the products of combustion alone have to be dealt with, which still contain a great portion of the heat produced during the first period. The conditions of the flame during these two periods are so entirely different, that it is quite reasonable that they should be separately and differently treated, and should not be considered as one, as has been hitherto invariably the case. Whilst chemical action is proceeding, the flame ought to be allowed clear space within which to burn; it should not be interfered with by surfaces of any kind, and it should be allowed freely to emit its radiant heat; whereas the products of combustion having very little power of radiation, and not injuring surfaces upon which they impinge, should be brought into contact with the surfaces to be heated, for the purpose of abstracting their remaining heat.

As is well known, combustion is interrupted when flame meets solid surfaces, whilst the solid surfaces themselves also suffer—not so much from the heat as from the mechanical action of the flame; to explain these circumstances various theories have been proposed, as well as to account for the fact that flame has great power of radiation in its first stage and little in its second. It is agreed in all these theories that the gases in combustion forming the flame are intensely excited, and that the molecules of gas are rotating around one another, or are otherwise in violent agitation. According to the electrical theory, which is the one accepted by the author, a flame consists of small but innumerable lightning flashes, and it is at once evident that when a solid body is brought into such a flame it obstructs the action of the flame by arresting the motion of the particles of gas which strike on it, as well as by its attraction and adhesion; the molecules of the gas being resisted in their motion, combustion cannot continue, at least in those parts nearest to the opposing surfaces. As a result, smoke is produced, enveloping the obstructing surfaces; and radiation cannot act because of its inability to penetrate the cloud of smoke in which the flame is enveloped. Then, as regards the action of the flame on any surface, it is quite natural to expect that if flame is composed of innumerable flashes of lightning, no surface or body exposed to it can long withstand its action. The flame in its first stage being composed of innumerable lightning explosions, and carrying free carbon, accounts also for its radiant power. In the second stage of the flame, as no chemical action is going on, and there is no free carbon to emit heat by its incandescence, the carbon being converted into invisible CO_2, it is quite natural that there should be little radiant action.

A flame radiates much better than a solid body. The reason of this is that each particle of carbon raised to incandescence within the flame acts as a centre of radiation, and emits its light and heat in every direction, whilst a solid body simply radiates from its surface. Thus, in the flat-flame burner the edge radiates out nearly as much light as the face, and would radiate out quite as much, only that owing to its narrowness some of the incandescent carbon particles come in the way of the light radiating from those behind them; whilst the Argand burner serves as an illustration of a hollow flame, the light radiating outwards, not only from the outer surface, but from the inner surface through the flame itself, and heat and light obey the same law in this respect. If the area of a flame is doubled, it radiates four times as much as originally; whilst a solid body, if doubled in area, radiates only twice as much as before. A volume of flame applied for heating by radiation cannot therefore be made too large from an economical point of view, because the radiation from a body of flame increases, not according to its outer surface, but in proportion to its volume.

From a careful consideration of the various circumstances thus set forth, connected with the production and action of flame, the author has designed a furnace, now well known as the radiation furnace, a short description of which in some of its applications will be given later on.

In order to employ radiation in the most profitable manner, a gas, rich in hydrocarbons, should be used, for the production of which special forms of gas producers may be adopted with advantage. Of these there are two so far employed. One of these was described by the late Sir William Siemens in his paper, "On the Use of Coal-gas as a Fuel," read before this Society on the 29th June, 1881. A diagram (Fig. 1) of this producer is placed before the meeting, and it may be shortly described as consisting of a cylindrical chamber truncated towards the bottom, which is filled with coal through a large hopper at the top; this chamber is formed of an iron casing A, covered on the interior with a lining of refractory material B, and in this lining passages C are arranged all round for the exit of the gases. A large opening at the bottom admits of the withdrawal of ashes and clinkers that may be found in the combustion of the fuel, and a blast of air—which by preference should be heated—is directed into the very heart of the mass of fuel.

The result is a very high temperature in the centre of the mass, one of the essential conditions for the total conversion of coal into combustible gas being a maximum degree of heat at one portion of the process, and no heat is lost at that point, which loss would

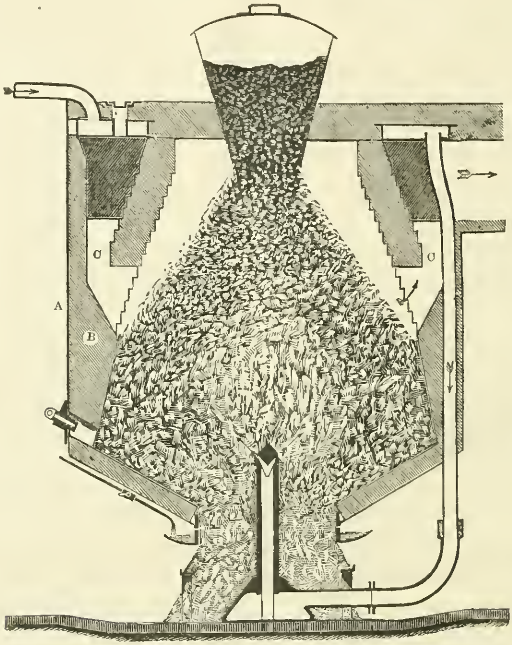


Fig. 1.

interfere with the due conversion of carbonic acid into carbonic oxide. At the same time, water, which is admitted by a continual streamlet near the bottom, is evaporated by the residual heat of the fire and clinkers which is thus utilised, and currents of steam are directed or drawn into the apparatus, passing through the zone of highest temperature towards the centre of the mass. They there become converted by contact with the incandescent fuel into carbonic oxide, and hydrogen (free from nitrogen), which add greatly to the calorific effect of the gas produced.

The modified form of Siemens' old-type producer, which is also employed for the purpose of enriching the gases by transforming the heavy hydrocarbons, that would otherwise form tar on condensation, is described in a paper read by the author's principal assistant, Mr. Head, before the Iron and Steel Institute, in May last, and published in the Journal of the Institute, Part 1 of the volume for 1885. The gas producer is divided into two compartments, one of which receives the hydrocarbons—the volatile constituents of the coal,—and the other the carbonic oxide formed by the decomposition of its solid carbonaceous matter. The proposed separation may be conveniently carried out by means of a curtain wall placed over the fuel, and by providing for the hydrocarbon constituents a separate outlet from the chamber thus formed.

Fig. 2 is a section of the modified gas producer arranged for this purpose, with the addition of the curtain wall A, which comes down to the level of the fuel at B, or may extend a little below it, dividing the gas producer into two compartments so as nearly to separate the zone B, where carbonic oxide is mostly

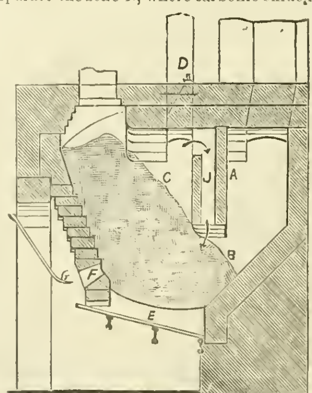


Fig. 2.

produced, from the zone C, where hydrocarbons are

given off. At the bottom is a grating E open for removal of ash or clinkers, and for admission of air. When increased action is desired, air may also be admitted to the body of the fuel by one or more nozzles F, formed in the brickwork, the supply current to each being maintained by a steam injector G. The nozzle and injector are so situated and directed as to provide against blowing flame or gases down through the grating E.

The hydrocarbon gases which collect in the chamber C, are led away by channels J, which heat the hydrocarbon products from the zone C, and direct them on to the incandescent fuel in the zone B, whereby they are further heated and converted into permanent gases. The curtain wall A need not absolutely separate the chambers B and C from each other, for if a small proportion of the volatile gases should leak into the carbonic oxide compartment, as in doing so they would come into contact with incandescent fuel, the desired effect would thus be ensured.

That gases may be enriched by converting the hydrocarbons into permanent gases, was determined for the late Sir William Siemens in the following manner. A certain quantity of gas was collected in a graduated receiver from one of the Siemens old-type gas producers; this gas was taken immediately above the fire through one of the stoking holes, and was found, on cooling to atmospheric temperature, to be reduced in bulk from 120cc. to about 85cc., the apparatus being at the same time much coated with tar. The receiver having been cleansed with spirits of wine and washed with water, another sample of gas from the same producer was taken, with this difference, that on its way to the receiver it was passed through a combustion tube, which was heated by a spirit lamp. The same volume being collected as before, the weight of gas taken would be somewhat less than on the previous occasion, and had the gas on cooling to atmospheric temperature been reduced to the same bulk as previously without deposit of tar, the result would have been considered satisfactory; but a better result was obtained, for the loss in bulk was only about 20cc., the receiver being comparatively free from tar. It is to be regretted that time would not allow of analyses of the gas obtained under these conditions to be made, but gas made from Staffordshire coal, in the Siemens old-type gas producer, has been found to contain less than 35 per cent. of combustible elements when working at its best; whereas, gas made from the same coal in one of the Siemens modified gas producers, described above, where the desired conditions for conversion of tar into permanent gases are present, has been found to contain 48 per cent. of combustible elements.

At a works where the Siemens old-type and new-type gas producers were tested comparatively upon two open-hearth steel-melting furnaces, the result was a saving amounting to 28½ per cent. in weight of coal in favour of the latter, the same quality of coal being used in each case, and the furnaces being erected to the same plans, and doing the same work. Recently a block of four gas producers of the Siemens old-type have been altered by the addition of a curtain wall provided with channels J as above described, in which similar results have been obtained. By making the curtain wall A solid, instead of with channels J, as shown in the diagram, the two chambers B and C will be divided from each other so that the hydrocarbons liberated from the fuel may be led away by a pipe D for treatment for ammonia and tar, while the gases resulting from its complete decomposition will be led away separately to the furnace.

In some works it may be found convenient, after treatment of the hydrocarbon gases for tar and ammonia, to utilise some of them for illuminating purposes. Owing to the inferior description of fuel usually employed in gas producers, as compared with that used at gasworks, the illuminating power of the hydrocarbon gases may not be found equal to the standard of the gas supplied by gasworks; but larger or additional burners can be used, and by this means manufacturers may almost entirely save their gas bills. Taking each burner as consuming 7 cubic feet per hour, even a hundred such burners, lighted for twelve hours each day, would not consume all the hydrocarbons liberated from a ton of coal. Moreover, the quality of the illuminating gas could be improved by adding a little cannel coal to the fuel charged in the gas producers, or in some of them, during the time that the gas is required to be used for illuminating purposes, and this will afford an alternative method to the employment of larger burners, or a greater number of smaller ones.

The gases not required for illuminating purposes should be returned to the main gas flue supplying the furnaces. Indeed, it is not desirable to use gases consisting mainly of carbonic oxide and nitrogen in regenerative gas furnaces, where the new method of heating by radiation is adopted, for which, as has been explained, gases rich in hydrocarbons are better.

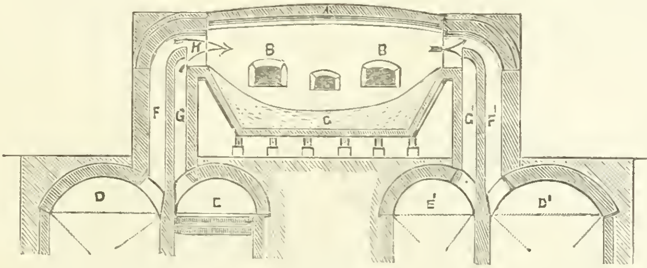


FIG. 3.

In designing the regenerative gas furnace, in which radiant heat is to work to the best advantage, it is necessary that the gas and air ports shall open at some distance below the roof of the heating chamber, and at some distance also from the side walls, so that the inflowing gas and air may have unobstructed space after ignition for entering into combustion, and for the free development of the flame; for the same and other reasons the flame is kept as much as possible out of contact with the material on the furnace bed,

B

and when these are crucibles, ingots, blooms, or packets of iron, they should be so placed that the radiant heat may play freely upon and about them.

The diagrams give sectional views of the furnace as now constructed for various purposes. A is the roof, B are the working doors, C the bed of the furnace upon which the materials are melted or heated, D and E are one of the pair of regenerators, and D^1 and E^1 the other pair, between which should be placed

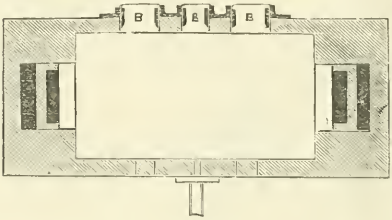


Fig. 4.

the pockets used for arresting the dust from the waste gases, as shown in Figs. 5 and 6. The gas and air are alternately brought into the heating chamber by the ports F, G and F^1, G^1, therein forming the flame which traverses it from end to end, as shown in Figs. 3 and 4, or sweeps round it in a semi-circular or horse-shoe form, as shown in Figs. 5 and 6. Where there are working doors, the flame should pass above K, so that it shall only commence at the entrance of the gas and air into the furnace chamber, and the combustion may be extended throughout the furnace,

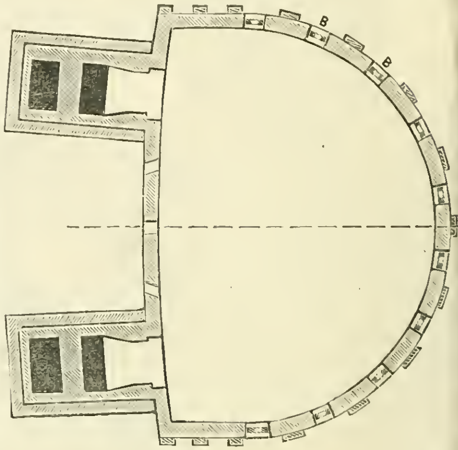


Fig. 6.

the flame in this case taking a semi-circular or horse shoe course.

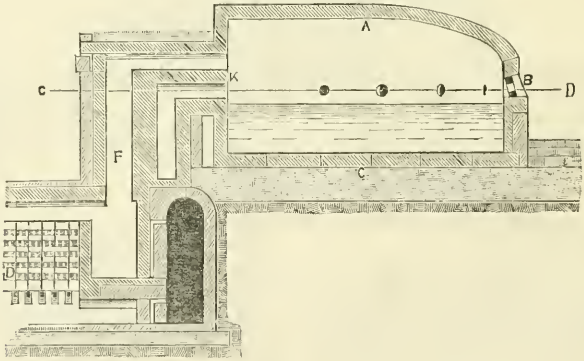


Fig. 5.

their level; in this way the men will not be inconvenienced while watching operations inside the furnace; but, as already mentioned, the main object to be secured is to avoid contact of the flame with the materials under treatment, or with the walls of the furnace.

As shown in Figs. 3 and 4, which represent an open-hearth steel-melting furnace, the air inlet may be arranged above the gas inlet, thus forming two parallel horizontal ports for the delivery of the gas and air in broad streams into the furnace chamber, the inflowing air overlapping the gas. In cases where there is a great length of travel for the flame, such as represented in Figs. 5 and 6, the ignition is retarded by extending the horizontal wall, or tongue

This new system of applying heat within the modified regenerative gas furnace has now been employed for a sufficiently long period to establish the economy of the method, as well in regard to the fuel used as to the material of which the furnace is constructed, and that treated on its hearth. One of the latest and most interesting applications has been to the open-hearth steel-melting furnace. At the Landore Works, the furnaces which were altered nearly eighteen months ago are still at work—a result entirely unprecedented in this class of furnace, which, as is well known, is worked at the very highest temperatures employed in the arts. But besides the longevity of the furnaces, they are found to work more uniformly, whilst the yield is larger, owing to

there being less oxidation of the metal, as is proved by more ore being used per ton of pig iron, in order to decarburise it to the same extent. The furnaces work much more uniformly, and with great economy as regards consumption of fuel. Various other steel works throughout the country, and several glass works, are now modifying their furnaces so as to obtain the benefits offered by this new method of heating.

Another important application is to forge, mill, and puddling furnaces, as, owing to the absence of contact between the flame and the materials with which the furnace is charged, a great reduction in the loss of metal which has hitherto occurred through oxidation will be effected.

In steel re-heating furnaces, contact of the flame with the ingots produces red-shortness in the metal, exhibiting itself in fissures, particularly at the corners of the ingots or blooms, when these are subjected to treatment either under the hammers or in the rolls. The removal of the injured portions involves a stoppage of the operations, resulting in waste, not only of material but of time also, and occasionally rendering the blooms entirely useless for the purposes intended. In the radiation furnace this cause of loss no longer exists, while there is also a saving due to non-oxidation of the metal.

In iron re-heating furnaces the saving in waste of metal will be much more considerable than in furnaces for the re-heating of steel, owing to the higher temperature at which they are worked, and the metal will weld much more easily, as it is heated out of contact with flame. These furnaces should be made as long and wide as convenient, in order to obtain as much room for the development of the flame as possible, and for placing the ingots, blooms or packets sufficiently far apart to allow the radiant heat to reach them on all sides.

As regards puddling, it might be advantageous to erect a furnace containing a number of pans, which could either be placed in two rows, the men working at each face of the furnace, or the men could work on a semi-circular face by constructing the furnace of a horse-shoe form. The side of each pan should be separated from the next by a partition containing air in circulation, or by a water channel.

In the same manner, a furnace heated by radiation from flame may be constructed of such size and productive capacity, that it may serve for heating all the metal for a mill or forge, or, at anyrate, two or three such furnaces should suffice for the output of several hundred tons of metal per day, the only consideration being the convenient location of the furnaces with regard to the position of the mills and hammers.

In heating furnaces constructed and worked, as hitherto, by contact of flame with the metal to be heated, the furnaces must necessarily be made as small as possible; for the flame under such conditions parts with its useful heat in a run of a few feet, after which the sooner it leaves the furnace the better. But when heating by radiation is adopted the conditions will be quite changed, for the flame not being brought into contact with surrounding objects (including the metal to be heated), will be kept at a uniform temperature throughout its course, radiating all the time the maximum heat required for the charge in the furnace; and when combustion has ceased, the hot gases will be deprived of their remaining heat through contact in the regenerators. It will perhaps be difficult for those accustomed to heat metal by contact with flame, to realise the possibility of effecting the same object better, more quickly and more efficiently by means of radiation; but to overcome the difficulty it is only necessary to associate heating by radiation exclusively with the regenerative gas furnace, in which both air and gas are raised to a high temperature before combustion, as without such initial heating a flame of high temperature, and one therefore capable of radiating intense heat, could not be obtained.

Bearing in mind that contact of flame with the metal to be heated is avoided, there is no reason why a heating furnace should not hold at the same time piles, blooms, or ingots in various stages of heating, from cold metal to metal which is ready for the hammers or mills. Each individual bloom, pile, or ingot will, under such conditions, take up from the heat radiated by the flame, only the amount which it is susceptible of receiving without interfering with its neighbour; but the blooms, piles or ingots must be placed sufficiently far apart to allow the radiant heat to reach them from all sides. In such an application it would be advisable to arrange the blooms or packets in the furnace, so as to form graduations of heated metal, in order that a cold bloom or packet, on being introduced into the furnace, may not be placed next that which is hottest at the time.

The new method of heating by radiation from flame, thus offers the solution to an objection which has sometimes been made against the regenerative gas furnace on the ground of its great cost, which has certainly limited its application for heating furnaces at iron and steel works in this country; but, when a few, or perhaps one furnace only, will be built for a mill, the capital expenditure on furnaces, even with separate boiler settings, should compare favourably with the cost of the old grate furnaces and boilers. Moreover, they will offer the advantages of saving in fuel, in wear and tear, and in metal.

Manufacturers who think that the suggestion which has been made is in advance of the times, and who might doubt the possibility of obtaining a flame of such a considerable length as would be required for a furnace to heat 100 or 200 tons of metal per day, will be pleased to learn that the problem has been already solved by the author in connection with the manufacture of glass. There exist many furnaces of the dimensions now foreshadowed for heating iron and steel, some of which have a run of flame of upwards of 40 feet; and one of them, measuring 42 feet by 16 feet 6in. inside dimensions, holds 130 tons of glass, is capable of producing 24 tons of glass per day, or at the rate of a ton of glass per hour, the consumption of fuel being about 18cwt. per ton.

These furnaces hold at the same time freshly charged (cold) batch and refined glass, the charging of batch and the gathering of refined glass being continuously carried on in same chamber.

On the present occasion it is not necessary to refer to details of the glass furnaces constructed respectively on the old and new principles, which the author has erected; but it may be well to state that the advantages of the new system are quite maintained. Thus fewer pot breakages occur, the loss by waste glass continues to diminish, and fewer repairs are required; moreover, a superior quality of glass is produced from a cheaper composition than hitherto employed. The gross results are that the new furnaces last six times as long, and melt more than nine times the quantity of material that they did previously to their reconstruction. The flame being kept away from the working holes, the glass-blowers work more at their ease, turn out a better product, and are able to reheat their glass in the furnace without tarnishing it.

With these advantages, and others of a minor character, a glass-blower is able to produce 50 per cent. more goods without much greater exertion. In another furnace in which lamp glass chimneys are

made, a more refractory material is employed than hitherto, and the glass produced is whiter and of better quality, whilst open instead of closed pots can be used for the production of superior qualities of glass, whereby a great saving in pots and fuel is effected.

Another most important application for the greater extension and improvement of which trials are now being made, is to the heating of boilers by means of gas; but in order to obtain the greatest benefit from this method of firing, it is necessary that there should be use for the gas made in the producers by night as well as by day. If flame is allowed to touch the sides of a boiler there is of necessity smoke produced on its inside surfaces, and the radiant heat of the flame not being able to penetrate such an atmosphere of smoke, the water in the boiler cannot get the advantage of it. It will readily be perceived how great a quenching effect the metal of the boiler has upon a flame, when it is remembered that the temperature of steam—which is, of course, that of the boiler—is only 311° F., even at 60lb. pressure, whilst that of the gaseous flame in contact with it is about 2000° F. In this application the principle has been followed of allowing the active flame to have free space for its development, and for the radiation of its heat within the length of the tube, and not allowing it to touch the sides until after complete combustion has been effected, when the products of combustion may be brought into direct contact with solid bodies. The way in which this is arranged is shown by the diagram Fig. 7, and by means of the little working model exhibited. The illuminating gas with which this model is supplied is deteriorated by partial combustion before reaching the flame outlet, so that it may be taken in that condition as not better than producer gas. If the flame was allowed to play along the tube in the ordinary way, it would very soon strike against the upper surface, producing smoke and soot, but by the arrangement of deflector rings inserted in the tube, the gas is not allowed to touch the surface of the tube until after complete combustion has been effected; and it will be noticed that by this means the flame has no discolouring effect on the tube. By this arrangement perfect combustion is produced, and there is no smoke. But besides this, a boiler fired in this manner lasts longer, because the flame being out of contact with the plates, these are not worn away so readily, boilers being more rapidly destroyed through direct contact with the flame than from almost any other cause. As the remaining heat of the products of combustion come into direct contact with the sides or flues of the boiler and its regenerators, it is completely utilised, and the maximum of heating effect is thus ensured.

Thus, in various applications that have been made, a saving in fuel has been effected which varies from twenty-five to thirty per cent. These results refer to ordinary horizontal flued boilers, to which only this method of heating has been so far applied; but a vertical boiler is being constructed by the author specially designed for the application of radiant heat, from which it is expected that even better results will be obtained.

Another valuable application which has been suggested by Professor Armstrong, F.R.S., is to the manufacture of coke in the ordinary beehive oven. A furnace for this purpose would be very similar in construction to the glass-melting furnace of horseshoe form, shown in Figs. 5 and 6, the flame radiating heat of a very intense character upon the coal to be carbonised, the gases being drawn away below the bed of the furnace by means of an exhauster, in the usual manner. In order to prevent the flame being drawn down by the action of the exhaust, small coal (mixed, perhaps, with tar) should be charged on the top of the mass of coal to be carbonised, so that on heat being applied it would bind the upper surface, forming a skin impermeable to the passage of gases. The gases withdrawn from the bottom of the furnace may be led away for the removal of bye-products, and then re-delivered to produce the heat required for carbonisation, and also utilised for other purposes.

There must be several applications of the radiation furnace to the chemical industries, which should offer important advantages. In some cases gas has been used with the sole object of avoiding the introduction of ashes or dust into the furnace; but where contact of the flame is not necessary as regards the chemical operations performed, the utilisation of the heat by radiation first within the heating chamber, and by contact afterwards with extended surfaces, will be a great step in advance of the mere application of gaseous fuel. It is hoped, therefore, that this paper will prove of interest to the members of this Society, and that it will lead to an interesting discussion.

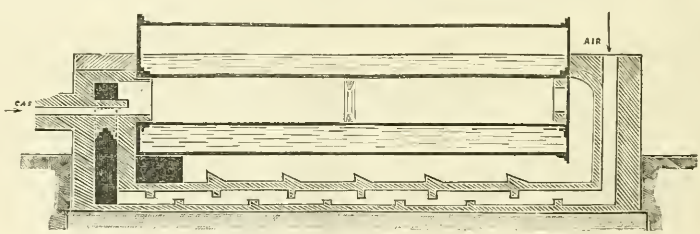


FIG. 7.

On the motion of Mr. MUSPRATT, seconded by Mr. CROWDER, a vote of thanks was unanimously accorded to Mr. Siemens for his paper, and it was resolved to defer discussion upon it until the paper had appeared in the Society's Journal.

On the motion of Mr. TYRER, seconded by Mr. CROWDER, a vote ot thanks to the authorities of the City and Guilds Institute for the use of their rooms was carried by acclamation, and the proceedings terminated.

THE ANNUAL DINNER.

The annual dinner of the members of the Society of Chemical Industry was held in the Freemason's Tavern, Great Queen Street, on Tuesday evening.

About 130 members and friends were present. The chair was occupied by the President (Dr. W. H. Perkin, F.R.S.), who was supported by Sir F. A. Abel, Mr. E. K. Muspratt (the President-elect), Sir J. McGarel Hogg, Mr. Walter Weldon, Professors Hugo Müller and Odling, Mr. David Howard, Mr. Ludwig Mond, Mr. E. Rider Cook, Professors Armstrong, Tilden, Meldola and others.

The first toast proposed was the usual loyal one. Mr. E. Rider Cook then proposed "The Houses of Parliament," responded to by Sir J. MacGarel Hogg, M.P. (Chairman of the Metropolitan Board of Works). "The Learned Societies" was the next toast, proposed by Mr. Ludwig Mond, and acknowledged by Dr. Hugo Müller, F.R.S. (President of the Chemical Society), and Dr. W. Odling, F.R.S. (President of the Institute of Chemistry). "The Society of Chemical Industry," was now proposed by Mr. Walter Weldon, F.R.S., and replied to by Mr. E. K. Muspratt. "The President" was the next toast, proposed by Sir F. A. Abel, C.B., F.R.S., and responded to by Dr. W. H. Perkin, F.R.S. Mr. David Howard then proposed "Our Guests," a toast which was suitably replied to by Dr. Löwenherz. The toasting was finally concluded by the President proposing "The Officers of the Society," which was responded to by Mr. Watson Smith and Mr. Tyrer. Interspersed with the toasts were several vocal and instrumental pieces, ably rendered by Messrs. A. Zimmermann, Max Schrattenholz, and F. J. M. Page.

THE EXCURSIONS.

MESSRS. ORLANDO JONES & CO.'S STARCH WORKS.

The first visit was on Wednesday morning to the starch works of Messrs. Orlando Jones, of Wandsworth. Divided into four parties, one of which was conducted by the head of the firm, the remainder by various other gentlemen, the company was led over the works, and the details of the manufacture of starch from rice were explained in a most interesting manner. The operation in this extensive and well-conducted factory, which probably excited most attention as being of a chemical nature, is that in which the gluten is dissolved and separated from the ground grain by treatment with dilute caustic soda solution. By a process of deposition and decantation the husk fibre and starch are separated. After working up into white masses the starch is cut into cubical blocks, and dried to a certain extent, when after packing in paper and placing in a drying chamber for three or four weeks, the starch is found with an apparently crystalline appearance, adding greatly to the beauty of the commercial article. The alkaline solution of the dissolved gluten, it is stated, is run off as waste, no use having been found for it. The fibre however is partly used in the moist state for cattle-food, whilst a portion is, after drying, submitted to a special treatment, and is then utilised by paper-makers for giving body to paper. A special product, which consists of a form of "wheaten flour," is prepared in these works. The bran which has been separated from the flour is finely ground and then restored to the latter, and in this lies the peculiarity of the preparation. A saccharine preparation is also manufactured from maize, after cleaning and crushing the grain.

MESSRS. JOYNSON & CO.'S PAPER MILLS

at St. Mary Cray were next visited, and here a luncheon was most kindly provided for the visitors. In these noted paper-mills were seen the several processes in their different stages, from the sorting of the rags, and the bleaching, to the manufacturing from the pulp of the finest brands of paper. Since only assorted rags are used, it is needless to say that only paper of the better and very best classes is made by Messrs. Joynson & Co.

THE BECKTON GAS AND CHEMICAL WORKS

were visited on Thursday morning, July 9th. A large party of about 400 were conveyed by the "Glenrosa," the finest boat of the London Steamship Company, from All Hallows Pier to the landing stage of the Beckton Gas Works, where the visitors were received by Mr. Trewby, the principal engineer. In these admirably conducted works the visitors were conveyed from one principal point of interest to the other by rail. The Beckton Gas and Chemical Works form the central station of ten other gas-works, carbonising about 1,500,000 tons of coal annually. It required no great perception, though it did some practical knowledge of the subject, to observe that the latest and best improvements in the arts of gas-making and tar-distilling are employed by this, the first, and we believe still the only, gas-company in the country supplying at once illuminating gas, pure coal-tar products, and dye-stuffs. In the gas works, the firing of the retorts with gas was an interesting feature, as also the mechanical and automatic apparatus for charging the coal into the retorts. In the tar distillery was seen to advantage the admirable system of setting the tar-stills referred to in Dr. Lunge's work on Coal-tar, *loc. cit.* pages 97, 98, and 99 (Fig. 4), so that the red-hot cinders never appear outside the stills, but are wheeled away under the same by a subterranean arched-passage, thus avoiding possibilities of fire or explosions. An interesting process for moulding naphthalene into corrugated sticks, for enriching illuminating gas by means of the well-known Albo-carbon lamp, was also witnessed in operation. The apparatus used somewhat resembles that by which a certain class of candles is made. The rectification of benzene, toluene, and xylene, is conducted in a well-appointed special department, and the fractionation is performed in a dephlegmating column. Sulphate of ammonia is manufactured in comparatively vast quantity in these works, the sulphuric acid used being prepared on the spot in extensive vitriol chambers. The chambers are supplied with sulphurous acid from pyrites burnt in the ordinary pyrites burners, and from spent oxide saturated with sulphur (from the oxide purifiers) burnt in shelf-kilns.

THE PUMPING STATION AT CROSSNESS AND DISINFECTANT FACTORY OF THE METROPOLITAN BOARD OF WORKS

was the next point of interest. At this station and factory an experimental process is being carried out for disinfecting London sewage. It was explained to the visitors by Mr. Dibdin, principal chemist to the Metropolitan Board of Works.

Manganate of soda is made, brought into dilute solution, acidified, and the acidified permanganate liquor well agitated with the sewage pumped up by gigantic pumping engines, working, despite the enormous amount of power expended, with wondrous silence. The water is afterwards returned, when disinfected, to the Thames at suitable periods of the tide.

THE NEW TILBURY DOCKS,

next visited, were interesting chiefly on account of the enormous scale on which the excavations and works generally are being carried on, as well as on account of the peculiar nature of the strata exposed in course of excavating. Mud deposits and peat bogs

appear to have covered this neighbourhood at one time, and deposited in these now, at a depth of some forty feet below the normal surface, are still abundantly to be found in an excellent state of preservation, trunks and branches of trees, as well as occasionally animal remains. The inspection of these extensive docks by the visitors was greatly assisted by the subdivision of the party into groups, each headed by an engineer, who explained the operations in progress. The weather throughout the day was most propitious, and this event had much to do in making the excursion such an enjoyable one. As the steamer neared All Hallows Pier on the return journey, Mr. J. C. Stevenson, M.P., in a few well-chosen and kindly sentences, proposed a vote of thanks to the Local Secretary of the London Section, Mr. Tyrer, for the most effective way in which he had carried out the numerous and multiform arrangements necessary in organising such a meeting, and thus contributing so largely to achieve a result so eminently successful. The vote, responded to most heartily, was then acknowledged in a few words by Mr. Tyrer.

THE CONVERSAZIONE AND RECEPTION.

On Wednesday, at half-past eight, the presidents of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry held a reception in the galleries of the Royal Institute of Painters in Water Colours, Piccadilly, W., where in the course of the evening about 1000 ladies and gentlemen assembled. The conversazione, amid surroundings so charming to the eye as well as to the ear, may be pronounced a brilliant success. An admirably-arranged programme of instrumental and vocal music, under the direction of Miss Adelaide Thomas, was carried out to perfection, with the assistance of Miss Mary Thomas, Miss Riley (violin), Mons. Albert (violoncello), Mr. Tapley (vocalist), and Mr. Marshall (accompanist). Conspicuous in this programme was the beautiful trio in D Minor by Mendelssohn for pianoforte, violin and violoncello, which was exceedingly well performed by Miss Adelaide Thomas, Miss Lucy Riley, and Mons. Albert.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	B. E. R. Newlands.
H. E. Armstrong.	B. Redwood.
W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	W. Weldon.
R. Messel.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885—First Monday in each month (unless otherwise indicated).

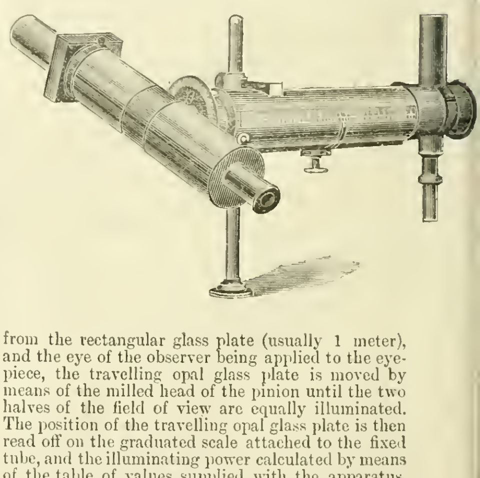
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held June 1, 1885.

NOTE ON PROFESSOR LEONHARD WEBER'S PHOTOMETER.

BY BOVERTON REDWOOD, F.C.S., F.I.C.

THIS instrument consists essentially of two tubes attached at right angles, in the form of the letter T, in such a manner that, while one is supported in a horizontal position, the other can be placed horizontally, or at any required angle. At the junction of the two tubes is a reflecting prism, by means of which, in combination with a diaphragm, the field of vision of an observer looking into an eye-piece, which forms one end of the movable tube, is divided vertically into two equal portions. One-half of the field is illuminated by the light passing through the movable tube, and the other half by light passing through the fixed tube. The source of the light passing through the fixed tube is a small lamp burning petroleum spirit. This lamp furnishes the standard light, and a scale is attached to enable the observer to measure accurately the height of the flame. Inside the fixed tube, between the petroleum lamp and the reflecting prism, is a frame, carrying in a vertical position a circular plate of opal glass, and travelling along the tube, from end to end, by means of a rack and pinion. At one end of the movable tube (the other end being furnished, as described, with an eye-piece) is a holder, in which a rectangular plate of opal glass (or, if desired, two or more of such plates) is placed. The petroleum spirit lamp having been lighted, and the flame adjusted to the height of two centimeters, the light to be measured is placed at a convenient distance



from the rectangular glass plate (usually 1 meter), and the eye of the observer being applied to the eye-piece, the travelling opal glass plate is moved by means of the milled head of the pinion until the two halves of the field of view are equally illuminated. The position of the travelling opal glass plate is then read off on the graduated scale attached to the fixed tube, and the illuminating power calculated by means of the table of values supplied with the apparatus. It is obvious that the travelling opal glass plate, being illuminated by the petroleum lamp, becomes itself, to some extent, a source of light; and the amount of illumination of one-half of the field, therefore, depends partly upon the proximity of this plate. If it is found that the light to be measured is so powerful that the standard side of the field is not equally brightly lighted, even when the travelling plate is brought as closely as possible to the reflecting prism, at the junction of the two tubes, the light may, of course, be removed to a greater distance, or a second opal glass plate may be inserted in the holder. Under ordinary circumstances both tubes of the photometer are in the same horizontal plane; but if it is desired to measure the illuminating power of angular rays, the movable tube, which is fitted with an arc divided into degrees, may be placed at any desired angle. The apparatus is also applicable to the measurement of diffused light.

The formula for calculating the illuminating power (B) of a flame from the readings obtained with the instrument, is: $B = k.C\frac{R^2}{r^2}(a+bl)$ normal (standard) candles.

In this formula the factor $k=1$ for such lights as are of the same colour as the standard light, C is the constant of the rectangular opal glass plate, R is the distance of the centre of the light to be tested from the rectangular plate, and r the distance of the standard light from the circular travelling opal plate. a and b are constants relating to the standard light, and l the length of the flame of the standard light. a and b have the respective values of $-0·88$ and $+0·94$, and are so calculated that when $l=2$ (the normal height of the flame being 2cc.) $a+bl=1$. Accordingly, when the height of the standard flame is maintained at 2cm., the expression $(a+bl)$ may be omitted from the formula. Moreover, when the standard flame is maintained between 1·9 and 2·1cm., the expression $(a+bl)$ may still be omitted, and the result corrected by subtracting or adding as much per cent. as l is tenth millimeters longer or shorter than 2cc. With each apparatus the values of the opal plates are furnished; but in the printed description of the apparatus Professor Weber describes how these values may be experimentally verified.

The photometer is remarkably portable and compact (it packs into a box 21in. by 10¾in. by 6in.), and it requires for its use no specially prepared dark room.

The principle of bringing the light passing through two tubes into a divided field of vision for comparison, has long been adopted in the construction of chromometers for liquids; but the writer believes that the credit of applying it for the measurement of light belongs to Professor Weber.

The writer is not in a position to express any confident opinion as to the merits of the instrument; but he hopes at a future date to give the results of his experience in its use. Opinions, however, frequently differ so widely in regard to photometric appliances that the experience of an individual appears to be of comparatively small value, and the writer's object in making this brief communication is to direct attention to Professor Weber's invention, in the hope that others engaged in photometric work may be induced to give the apparatus a trial. In the meantime the writer may mention that he saw the instrument in use in the laboratory of the Normal Aichungs Kommission, in Berlin, and was informed that the results obtained with it compared very favourably with those furnished by the ordinary photometer.

DISCUSSION.

Messrs. F. W. Hartley, W. Dibdin, and Dr. P. F. Frankland criticised the details of construction of Professor Weber's photometer, and specially complained that operators were left with arbitrary standards, even more than in the older forms of photometer.

Mr. Redwood pointed out that he had claimed nothing as yet for the instrument; but he should feel it incumbent upon him to give the benefit of his investigations in a future communication.

ON THE SOLUBILITY OF NITRIC OXIDE IN SULPHURIC ACID.

BY G. LUNGE.

In some recent communications to the Chemical Society I have mentioned the analytical operation performed by means of the "nitrometer," described by myself sometime ago. Mr. A. H. Allen has lately described a number of new and highly interesting applications of this apparatus.* In this paper he has mentioned a few circumstances which he considers as drawbacks, to be avoided by special means. One of these is the formation of a persistent mercurial froth, which delays the reading. Allen mentions a way of avoiding this delay, but I do not think it even desirable to do so, as a certain time should elapse after shaking the apparatus, both to give time for the temperature of the gas to be equalised with that of the surrounding air, and for allowing all the acid to run down from the sides of the measuring tube. The froth sometimes observed at the top of the acid, which is far more troublesome, is easily avoided by a sparing use of grease in the glass tap, and when employing vaseline I have never been troubled at all with such froth.

It seems a more serious objection that Allen believes sulphuric acid to have a notable solvent power for nitric oxide; hence he recommends the acid to be diluted below that point where this solvent action becomes appreciable, in the proportion of three measures of strong acid to two of water. Allen bases this upon experiments made at his request by Mr. T. Bailey, according to which, in the case of acid of sp. gr. 1·62, the extra gas obtained after further diluting was fully 0·5cc. With stronger acid this source of error is said to become even more serious.

If Bailey's experiment were to be trusted, even the dilution recommended by Allen would not be sufficient, for strong oil of vitriol at 1·84, diluted with two-thirds its volume of water, yields acid of 1·62, at which strength Bailey asserts it to retain still 0·5cc. of gas. If this were correct, one could only wonder that thousands of tests had been made without noticing so grave an error. But this is not the case; the following shows that Bailey's result can only be accounted for by an experimental error, perhaps just in consequence of taking the reading with too little delay.

C. Winkler and J. Kolb have tested the solvent power of strong sulphuric acid for nitric oxide. Both of them found it not appreciable, the acid not having any action upon potassium permanganate, after NO, free from air, had been passed through for a long time. These experiments had to be repeated in order to discover any slight action overlooked by Winkler and Kolb. First of all I operated by shaking up from time to time from 6 to 12cc. of sulphuric acid with pure nitric oxide in the nitrometer, reading the volume of gas, diluting with from 4 to 10cc. of water, shaking again, allowing to cool down, adjusting the levels properly and reading again. This was repeated a good many times with new quantities of acid. The increase of the volume of gas on diluting the acid amounted to 0·05 up to at most 0·15cc.; the larger amount was found when diluting more strongly, and was evidently caused by the vapour tension of the dilute acid. The real increase of volume is only 0·05 or at most 0·10cc.—a magnitude to be neglected in most cases, whilst 0·5cc., as stated by Bailey, would cause a gross error. But even the small amount found in the above-mentioned tests probably is not caused by any evolution of NO, as will be seen from the following.

I now made a direct test of the solubility of nitric oxide in sulphuric acid. This I did as well by means of my nitrometer, which is most eminently adapted for this purpose, *and is altogether in many cases the*

* *Journal of the Society of Chemical Industry*, 1885, p. 178.

most convenient absorptiometrical apparatus. A given quantity (from 15-20cc.) of very pure sulphuric acid was introduced into the measuring tube; the air was expelled by raising the level tube; the three-way tap was so placed that the cup communicated with the lateral bore, whereupon the cup was rinsed and dried. Now the tap, still in the same position, was connected with the drying tubes of a gas holder containing nitric oxide, and dry NO was passed through until all air had been expelled from the connecting tubes and the cup. The tap was now turned 180 degrees, so that the lateral bore communicated with the measuring tube; by lowering the level tube a few cc. of NO were drawn in, the tap was closed and the connection with the gas holder severed. The cup was filled with water, in order to remove the NO, the water run off by the lateral bore of the tap, and the cup dried. Now the contents of the nitrometer were thoroughly shaken up from 50 to 100 times, which can be done much more conveniently than with Bunsen's heavy absorptiometer. The level tube was now placed so that the mercury balanced not merely the pressure of the column of acid within the measuring tube, but also the difference between the actual barometrical pressure and 760mm. (Of course it would have been easy to work at a lower or a higher pressure, which is just a special advantage of this apparatus.) After standing some time, the gas was driven out of the measuring tube by raising the level tube and opening the tap, and the latter was sideways connected with a narrow glass tap burette, which allowed reading up to 0·01cc. A current of CO_2 had previously been passed through the burette, and this was continued to the end of the titration, in order to prevent the air from acting upon the NO dissolved in the acid. The acid was now forced over into the burette, and was run from this into a very diluted, but exactly titrated solution of potassium permanganate, until the colour was discharged. Since very slight quantities had to be estimated, only 1cc. of a solution was employed, whose oxidising power was equal to 0·000196grm. O or 0·000245grm. NO; this was diluted and gently heated before running in the acid. Previously it had been found that 1cc. of the permanganate required 28cc. of the acid before treating it with NO; hence for each cc. of strong acid used in titrating, 0·036cc. permanganate had to be deducted.

The observations yielded the following results:—

(*a*) Concentrated sulphuric acid, of sp. gr. 1·84 = 96 per cent. H_2SO_4, saturated with NO at 18° C. and 760mm. pressure, in two experiments absorbed so much NO that 4·33 resp. 4·22cc. of acid was required to decolourise 1cc. of permanganate; that is a mean of 4·28cc. Deducting from this 4·3 × 0·036 = 0·15, there remains 4·13cc. acid—*i.e.*, 1cc. acid = 0·242cc. permanganate = 0·0000593grm. NO = 0·035cc. NO.

(*b*) Dilute sulphuric acid, of sp. gr. 1·500 = 60 per cent. H_2SO_4, absorbed so much NO at 18° C. and 760mm. pressure, that in two experiments 1cc. permanganate required 8·42 resp. 8·90, or a mean of 8·66cc. acid. Deducting 0·15, there remains 8·51cc., or 1cc. acid = 0·117cc. permanganate = 0·0000287grm. NO = 0·017cc. NO.

Since the acid *a* must be mixed with an equal volume of water to produce the acid *b*, 0·017cc. NO in 1cc. of the acid *b* corresponds to 0·034cc. NO in 1cc. of the acid *a*. In reality the latter had only contained 0·035cc. NO. *Hence on diluting acid of 1·84, saturated with NO, with an equal volume of water no nitric oxide at all is set free.* Therefore Bailey's observation must be erroneous, and it is not possible to correct any presumed error in the nitrometer readings by dilution with water. But that error, according to the above experiments, is so slight that it need not be taken into account in any ordinary case.

Mr. Allen's valuable paper has caused me to take up the question of further uses of the nitrometer. I cannot, for most purposes, approve of his plan of substituting strong brine and the like for mercury; and I consider this a distinct and quite uncalled-for deterioration of the capabilities of that apparatus, except in a very few cases—for instance, when testing sweet spirit of nitre. Otherwise, I prefer attaching to the side of the three-way cock a light flask, with an inside tube soldered on to its bottom, and connected with the cock by means of a short stout caoutchouc tube, so that it is suspended without any other support. In this I perform the analyses of sodium and potassium carbonate and bicarbonate, of caustic soda or lime (for carbonate), of calcium carbonate, marl, etc., of manganese ore by means of oxalic acid, of oxalic acid or oxalates by means of MnO_2, of acids, especially acetic acid, by means of carbonates, of the free acid in many metallic salts, and so forth; always employing Dietrich's tables for the solubility of CO_2 in the liquid (Scheibler's co-efficient is altogether wrong). The alkaline bromine solution serves in the same apparatus, not merely for the estimation of urea, but for that of ammonia salts; in both cases taking into account the incompleteness of the reaction, which in the case of urea amounts to 9 per cent, in that of ammonia salts to 2½ per cent., of the total quantity. The evolution of equal parts of oxygen from hydrogen peroxide and an acidified solution of potassium permanganate can be utilised not merely for testing the former, but equally so for the latter, by employing an excess of H_2O_2; and I find this a perfectly correct way of standardising permanganate solutions, without the aid of balance, or weights, or substances of known composition. Moreover, I find that bleaching powder and manganese ore can be equally well estimated by means of H_2O_2, and H_2O_2 by the former, the evolution of oxygen following precisely the same law as with $KMnO_4$. I have made a great many experiments on all these points, and I find that the nitrometer can be generally employed for all analytical operations in which is evolved a definite quantity of a gas, not soluble to a very considerable extent in the liquid from which it has been evolved, and not acting upon mercury. By a contrary reaction I employ the nitrometer for estimating indigotin in reduced solutions of indigo, by means of the absorption of oxygen. The same apparatus serves very well for measuring and analysing the gases dissolved in water or other liquids. I also utilise the nitrometer as a general apparatus for gas analysis, but in a totally different way from that employed by Mr. Allen—viz., in some cases by acting upon the gases within the measuring tube itself, in others by attaching to its tap Hempel's absorbing pipettes. To all these purposes my nitrometer is adapted by the three-way cock, which is wanting in those other pieces of apparatus whose authors have adopted the name brought forward by me. That cock can be replaced by a plain one when employing the nitrometer as an apparatus for reducing volumes of gases to normal conditions of temperature and pressure, by confining in it a certain volume of air which occupies exactly 100ccm. at 0° and 760mm. All this and several other matters have been described in more detail in the June number of the *Chemische Industrie*, and in the English translation of Clemens Winkler's "Manual of Technical Gas Analyses," now in the press.

Glasgow and West of Scotland Section.

Notices of papers and communications for the Meetings to be sent to the Local Secretary.

ERRATUM.—In Mr. FAWSITT's paper on "Wood Naphtha," printed in the May issue of this Journal, the following error occurs:—In the 6th line of the small table of the Constituents of Wood Naphtha in column 1, page 320, "Di-methyl Acetate" appears instead of "Di-methyl Acetal."

Communication.

ON DR. CLARK'S PROCESS FOR THE ESTIMATION OF SULPHUR IN PYRITES.

BY G. LUNGE.

IN the *Journal of the Society of Chemical Industry*, May, 1885, p. 329, Dr. Clark describes a new dry process for estimating sulphur in pyrites, which, according to Mr. Tatlock's expectation, is destined to revolutionise the analyses of pyrites. Dr. Clark thinks his process called for, since the ordinary wet process involves certain errors which do not exactly counterbalance each other; but he admits that the wet process, if properly carried out, yields very constant results, and this is indeed best proved by his own experiments as quoted p. 330. His own method generally yields results about ½ per cent. higher than those of the wet process. I shall not stop to inquire whether Dr. Clark's method is really preferable to the dry methods previously known, especially that of Fresenius. But it is strange that in mentioning the various papers published on the estimation of pyrites by Fresenius and myself, Dr. Clark should have omitted to notice *why* I had objected to Dr. Fresenius' method. My reason for rejecting *any* dry process for the estimation of sulphur in pyrites is that in this way we estimate also the sulphur of galena (which is nearly always present) and of the sulphates of barium and calcium, none of which are of the least use to the consumers of pyrites, whilst in the wet process nearly the whole of that useless sulphur is left behind in the insoluble residue. I should therefore, on behalf of the buyers, strongly deprecate the introduction of Dr. Clark's or any other dry process as the ordinary trade analysis of pyrites, or even the optional use of it by commercial analysts. In this case I cannot agree with Mr. Tatlock that chemists have nothing to do with these matters, their sole concern being to render methods of analysis as perfect as possible. It is a delusion to speak of a more complete estimation of sulphur in pyrites, as something fair and just. Pyrites consumers do not want to buy galena or heavy spar, they want to buy *pyrites;* the chemists who regulate the price to pay for a special parcel by their analysis are not supposed to perform a scientific operation, irrespective of all other considerations, as they would have to do when working for theoretical purposes, but it is their duty to employ such methods that the results indicate *what the article in question is worth.* This value is entirely depending upon the sulphur of the pyrites itself, and if the chemist in his certificate returns the total sulphur, including that of galena, heavy spar, etc., he actually deceives the buyer as to the value of the ore in question.

Before my process of testing pyrites was generally adopted between buyers and sellers in Germany, there were constant disputes owing to the discrepancies between the returns of different chemists; since that time I am informed that there are hardly any disputes of that kind. Fresenius himself has tacitly given up his opposition to my process; and Dr. Clark's process would be as objectionable in the above respect as that of Fresenius. It is not likely that in future pyrites consumers will quietly submit to paying for an additional half per cent. of sulphur which is of no use to them, and I do not doubt that the attempt to "revolutionise" the analyses of pyrites in this way will fall to the ground.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Refrigerating Machines for the Production of Clear, Transparent Ice. Dingl. Polyt. J. **256**, 69.

THE "Gesellschaft für Linde's Eismaschinen," Wiesbaden (Ger. Pat. 26,981, July 10, 1883).—A series of lancet-shaped paddles is suspended in the freezing tank, which, working by means of a mechanical arrangement, keep the water in motion. The speed of the circulation, through the peculiar construction of the apparatus, decreases in the divisions of the tank with the fall in the temperature of the water. O. Kropf, Nordhausen (Ger. Pat. 28,230, February 16, 1884), recommends for the same purpose the employment of a suction and pressure pump. A. Schwirkus, Berlin (Ger. Pat. 30,031, March 18, 1884), adds lime, and frees the water from gases by means of an air-pump, previous to freezing it.
—F. M.

Improvements in the Manufacture of Ice and Apparatus therefor. H. H. Lake, London. Eng. Pat. 9651, July 1, 1884.

THE invention refers to improvements in that class of ice-making machines in which cold is produced by vapourising water by means of a vacuum maintained through the rapid removal of vapour as formed, the chief object of the invention being the construction of an improved machine for the production of a block of ice by that method and for its removal when formed. In carrying this out in one way, the inventor uses an inclined cylindrical vessel provided with a piston upon an axis or shaft, which piston on rotating over the mouth of a basin filled to the brim with water, covers one-half of its lower surface with a thin film of water, the other half of its surface being exposed to the refrigerating influence of a vacuum. As the piston revolves it exposes to the cold a continued film of water, and thus gradually increases the thickness of the coat of ice on its lower surface, provision being made for the piston to yield by sliding along of or with its shaft to make room for the increasing thickness of the ice. Upon completion of the block, the upper part of the inclined vessel, together with the piston and its axis holding the block, are removed, and on the admission of steam through the shaft and into the hollow piston, the block is released and slides off. Other arrangements with horizontal and

vertical cylindrical vessels, and including various methods of producing the film of water, are described, and special provision is made in every modification of the apparatus with the view to preventing the exposure to evaporation of any portion of the water used, excepting that which constitutes the film for congellation. By this means the inventor calculates upon maintaining a constant supply of fresh liquid surface for freezing. Sulphuric acid may be employed in aid of the absorption of the vapour abstracted from the vessel, or cold air may be blown into the vessel for the purpose of freezing the film of water, instead of making use of the principle of evaporation in vacuo. The specification is illustrated with fifteen sheets of drawings.—B.

II.—FUEL, GAS, AND LIGHT.

The Heat of Combustion of Ronchamp Coal. M. Scheurer-Kestner. Bull. Soc. Chim. Oct. 5, 1883.

This is an account of an experiment undertaken by the author to verify some results obtained by himself and M. Meunier-Dollfus fifteen years ago, which have been disputed by MM. Bunte and Stohmann. The calorimeter used was a Favre-Silbermann, just as in the original experiment. Below are shown the composition of the coal (ashes being deducted), and the results obtained compared with those obtained for samples of nearly similar composition in 1869:—

	No. 1 Sample, 1869.	No. 2 Sample, 1869.	Present Sample, 1884.
Carbon	89·96	88·38	89·09
Hydrogen	5·09	4·42	5·09
Nitrogen	1·28	1·20	1·30
Oxygen and Sulphur	3·67	6·00	4·52
	100·00	100·00	100·00
Heat of combustion (calories)	9167	9117	9130

—A. R. D.

Improved Means for Generating Steam by Chemical Agents. Amended Specification. H. H. Lake, London. From H. Grüneberg and E. Harat, both of Cologne. Eng. Pat. 4295, March 3, 1884.

In the original specification it was proposed to employ the heat developed by the combination of lime or concentrated sulphuric acid with water for the generation of steam. The amendment consists in the omission of sulphuric acid, leaving caustic lime as the sole agent.
—A. R. D.

Improvements in Apparatus to be employed in the Manufacture of Candles. L. J. Pirie. Per Carpmael & Co. Eng. Pat. 12,954, Sept. 29, 1884.

In moulding candles with conical fluted ends, rings are employed to mould these ends. The purpose of the apparatus described is to free the thick ends of the candles from these rings, and it is applicable to the ordinary candle-moulding machines in use in England. It consists essentially of a subsidiary frame with rails, upon which the candles are laid horizontally, after being pushed out of the moulds in the ordinary way; one of these rails is movable, and works a set of plungers, forcing the candles out of the rings, while the rings are themselves retained in their place by another rail.
—W. L. C.

Improvements relating to the Manufacture of Coke, and to Ovens therefor. H. H. Lake, London. From Messrs. Wirth & Co., Frankfort-on-the-Main (Agents of Franz Brunck, Mannheim). Eng. Pat. 8453, February 27, 1885.

According to this invention, the retorts are of cup-shaped section, and the side walls thereof are as nearly vertical as possible. This prevents the formation of injurious cracks in the coke-cake, and allows the walls to be very thin, but nevertheless strong. To increase their stability, the partition walls and the heating flues between the retorts rest upon the arch of the heating channel or furnace below. Wherever possible, the coal in the retorts is compressed when filled, and a furrow or trough is made in its upper surface to secure a more equable distillation. With a view to enable the coke-cake to retain its heat, this trough or furrow is filled with lime, small coke, or the like. Any mechanical device for compressing the coal and making this trough may be used. Small coke powder added to the coal, and well mixed, has the effect of reducing the number of injurious cross-cracks. Coals rich in gas, and also in water, are mixed with tar and pitch, and made into bricks of a pierced or stellate section, so that the moisture may the more readily escape in the coking process. From the retorts the coke is drawn into a train of slaking waggons which pass below the retort doors. Instead of falling direct into these, it tumbles over sloping, pierced surfaces, or grates, which allow the small coke to pass through, and deliver only pieces of the proper size into the waggon.—A. R. D.

Improvements in the Manufacture of Hydrogen Gas. A. H. Reed, London. From G. E. Moore, New York. Eng. Pat. 3776, March 24, 1885.

This is a process for treating hydrogen and carbon compounds for the oxidation of the carbon to carbonic acid, in which form it may be readily eliminated, leaving pure hydrogen. The hydrogen and carbon compounds, in a suitably divided state (generally as a gas or fine spray), are brought into contact with the oxide or oxides of iron, manganese, copper, tin, lead or zinc, in the presence of a steam jet. The metallic oxides must be raised to the temperature required by the process, and the steam is preferably superheated. During the operation, the oxides are said to be alternately reduced and reoxidised, acting as carriers of oxygen between the steam and the carbon compounds, so that all the carbon present is converted into carbonic acid, and leaves the chamber in which this is effected mixed with the hydrogen originally present and that resulting from the decomposition of the steam. The carbonic acid may be removed by any known method, such as absorption by lime, or by water under pressure, or by solution of alkaline carbonate.—A. R. D.

Improvements in and Apparatus for obtaining Gas from Hydrocarbons. J. F. Schnell, John Read, Jas. Warwick and William Derbyshire, Manchester. Eng. Pat. 9532, March 27, 1885.

This invention consists in impregnating atmospheric air with a mixture of "benzoline" and ether, or "gasoline." If for heating purposes, the proportions recommended are a gallon of the first to six ounces of the second or third. If the gas is specially required for illumination, one ounce of paraffin should be added. The impregnation takes place in a closed vessel, divided into compartments filled with pumice-stone. This vessel is filled to a certain depth with the hydrocarbon mixture, and the air is caused to pass through the crevices between the blocks of pumice—openings in the partitions directing it in a zig-zag course through the apparatus.
—A. R. D.

An Improvement in Gas Producers. Richard Howson Middlesborough. Eng. Pat. 13,467, April 8, 1885.

According to this invention, it is proposed to conduct the air blast downwards, instead of upwards, through the mass of fuel in the producer. The advantages are chiefly that it prevents the charging apparatus from getting unduly heated, while the tar and coal-dust issuing from a fresh charge of fuel are carried through a mass of glowing coke, and thereby vapourised. This also prevents the choking up of the flues.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Note with reference to the Methods proposed for Coking Coal and Recovering Volatile Matters. H. E. Armstrong. Jour. Iron and Steel Institute, 1885.

The author is of opinion that in coking coal, the mere collection of the volatile matters evolved is not sufficient for a satisfactory solution of the problem at issue, because, even if the operations be always so conducted as to yield coke of good quality, the quantity and character of the volatile products will vary considerably for each particular class of coal, according to the conditions under which coking is effected The results obtained by Watson Smith in his examination of the tars from the Simon-Carvès and Jameson ovens, and from the Gartsherrie blast furnaces, afford ample proof of this. Although our knowledge of the chemical composition of coals is very imperfect, the author considers it in the highest degree probable that coals, especially those of bituminous character, for the most part consist of very complex compounds, which are not the mere residues of the primeval vegetation preserved to us as coal, but have resulted from the occurrence during the lapse of ages of a variety of complex chemical changes. The compounds present in ordinary "high-temperature" tars, such as are obtained in gas-making, and in the Simon-Carvès tar are not for the most part immediate products of distillation, but are formed from the latter by a variety of secondary chemical changes, which in part are of an analytical, and in part of a synthetical character. On the other hand, tars such as have been obtained from the Jameson ovens and the Scotch blast furnaces are said to more nearly represent the primary products of distillation of coal, and the author regards these as "low-temperature" products. The Simon-Carvès tar is said to closely resemble ordinary coal-tar, The Jameson tars, however, contain large quantities of paraffinoid hydrocarbons, such as occur in shale oil. The Simon-Carvès tar is stated to be equal in value to ordinary coal-tar; and, although reliable information on this point is wanted, the opinion appears to be gaining ground that the Simon Carvès tar is a satisfactory product, because it resembles coal-tar, whilst the Jameson tar, being unlike coal-tar, is an unsatisfactory product, and contains little that is of immediate value. Hence the Simon-Carvès oven has been strongly advocated as affording a solution of the problem at issue. The author is entirely opposed to this opinion, and considers, moreover, that chemically the method followed in coking coal in the Simon-Carvès oven is irrational as compared with that followed when coking is effected in the beehive oven as modified by Jameson. Coal-tar is a mere by-product of the manufacture of coal-gas, and in its production no attempt is made to secure a product having special qualities; it therefore by no means follows that because a product equal in value to ordinary coal-tar is obtained in coking coal, the best product which it is possible to obtain from the material at disposal has been secured, or that, in obtaining this product, much that is valuable has not been lost. Moreover, coal-tar is what the author terms a "final" product; it cannot well be dealt with in any way so as to improve its quality, whilst the Jameson oil is not a final product, since its quality can be improved. By passing it through red-hot retorts, it may be made to yield a considerable quantity of very rich illuminating gas, and a large proportion of benzene and other valuable products such as are present in ordinary coal-tar. (This Journal, vol. iii. 462.)

The author's objections to the construction of the Simon-Carvès oven are—firstly, because the heat is applied externally, and, therefore, more or less wastefully; and, secondly, because the mass of coal is first heated to redness on its exterior, and all the products of distillation are then necessarily forced to pass through a red-hot carbonaceous shell, thus giving opportunity for the occurrence of a variety of chemical changes which tend to deteriorate the product. His idea of a theoretically-perfect coke-oven is somewhat as follows:—It would consist of an oven resembling the present beehive oven, but with the upper part largely extended so as to form a furnace chamber of the type recommended by F. Siemens. Heat would be radiated upon the surface of the charge of coal, which would soon become coked, thus forming a protecting layer below which distillation would take place, the products being drawn away as rapidly as possible, and at as low a temperature as possible through the cool bottom of the oven. As slight an excess of air as possible, if any excess, being admitted to the furnace above, the small proportion of products of combustion which penetrated the upmost layer would carry no oxygen with them. On this account, and because of the large volume of steam and of other gases generated within the mass, and because of the low temperature, the ammonia would probably almost entirely escape destruction. The gas sucked away would be of low quality as an illuminant, and would be available for carbonising, oil and ammonia having been removed from it by efficient scrubbing.

—D. B.

Recent Results with regard to By-products obtained in Coking Coal in the Simon-Carvès Coke-Ovens. Watson Smith. Jour. Iron and Steel Institute, 1885.

In view of the fact that the Bear Park Company has recently started operations with fifty of the Simon-Carvès coke-ovens, with improved recuperating arrangements, and at the same time with a different class of coal to that used by Messrs. Pease (see *Jour. Iron and Steel Institute*, 1884, 2, 509; and this Journal, vol. iii. 505), the author gives an account of the results obtained by this firm in the direction of the recovery of by-products. The temperatures obtained in the Bear Park ovens are, if anything, higher than those at Pease's West, near Darlington. Analyses of the tars obtained at Messrs. Pease's and at the works of the Bear Park Company show that the tar obtained from the ovens employed by the Bear Park Company much more closely resembles normal gas-retort coal-tar than that obtained from the coke-ovens at Pease's West. It is generally richer in benzenes and phenol, and though less rich in naphthalene and anthracene, it is, nevertheless, still a tar very rich in these substances. The author is of opinion that in the English works employing the Simon-Carvès oven, condensation is still imperfect, and the methods for most efficiently recovering tar and ammonia are not much beyond the stage of infancy, so that it is somewhat premature, as yet, to attempt to set bounds to the value of the Simon-Carvès ovens as producers of coal-tar and ammonia. With respect to the employment of very high temperatures in carbonising coal in closed vessels, it is interesting to find that practically the very highest temperatures that can be employed are the best for the production of benzene. The author regards the tar obtained at present in the works of the Bear Park Company as equal to the best Lancashire coal-tars. The proportion of tar obtained on the coal carbonised is also stated to be greater than that obtained elsewhere. One difference from ordinary gas-retort tar is observable even in the Bear Park product—viz., that the carbolic acid is less in amount in this latter tar, about 0·3 per cent. against about 0·5 per cent. as the lowest average from the ordinary gas-retort. The author thinks this less quantity of phenols is due to the fact that the tar vapours in the Simon-Carvès ovens have to pass through a very considerable mass of superincumbent coke at a very high temperature, and the rate of aspiration from the highly-heated atmosphere of the ovens is comparatively and of necessity very slow.

Referring to Schulze's theory, that the primary products of the dry distillation of coal are phenols (this Journal, vol. iv. 335), the author states that if this view be correct, and phenols are primarily formed on the distillation of coal, then with a lower distilling temperature we might expect to obtain tars richest in phenols, and at more elevated temperatures the phenols should diminish and hydrocarbons proportionately increase. This is so in the case of both Pease's and the Bear Park tars, but when a close distillation is carried on at low temperatures, with shales or cannel coal, as in the Scotch paraffin industry, tars are obtained which are rich in paraffin but poor in phenols. This circumstance does not seem at first sight to bear out Schulze's theory, unless it be considered that the points of temperature at which a

maximum yield of phenols is obtained, and that at which they decompose to yield hydrocarbons, lie somewhat near together, and that the temperature employed in the distillations in the paraffin industry are in the main below those necessary to produce aromatic substances, and amongst them phenols.

The author has found the benzenes distilling constantly between 80° and 82°, and prepared from the tar from the Simon-Carvès coke-ovens, to be very rich in thiophen, by comparing the indophenin reaction obtained with such benzenes with the reaction obtained with benzenes of other origin, from which he concludes that a high temperature and exposure to prolonged contact with red-hot coke rather favours than otherwise the production of thiophen. By applying the indophenin reaction to the benzene obtained from light shale naphthas or spirit, no trace of thiophen was found to be present; this experiment would appear to show that the temperature of formation of thiophen lies higher than that necessary for the formation of benzene, and it is possible that a carbonising temperature might be adopted, at which benzenes are produced more or less free from the thiophens.

Since the reading of the author's paper before the Iron and Steel Institute, in Chester, in 1884, Maderspach and Siersch have adapted the Appolt coke-oven for the recovery of by-products. It is proposed to use a similar alternate regenerative heating arrangement to that adopted by Otto in the case of his coke-ovens. The author thinks that, as a whole, ovens with bottom flues, as well as side flues, must work better. The ovens patented by Maderspach and Siersch have side flues only. —D. B.

Recent Results and Further Development of the Simon-Carvès Coking Process (Utilisation of By-products). H. Simon. Jour. Iron and Steel Institute, 1885.

AFTER referring to the progress made in the Simon-Carvès coking process during the twelve months which have elapsed since the last summer meeting of the Iron and Steel Institute, the author discusses the working and construction of the ovens. To give the best results these ovens must be driven at a temperature varying as little as possible. Variations of temperature affect the quality of coke and influence the wear and tear of the ovens. It is also of extreme importance to charge and draw the ovens regularly, as this is the only way of obtaining the maximum of good results, not only in quality and quantity of by-products, but also in obtaining these by the least expenditure of intelligent labour and of wages. The author then refers to the utilisation of by-products at the works of the Terrenoire Company, near St. Etienne, where the gas, after having undergone the usual treatment for the recovery of by-products, is, before being burned in the ovens, subjected to a further process for the extraction of benzene and other light hydrocarbons. (See this Journal, iv. [5], page 338.) —D. B.

Natural Gas Fuel, and its Application to Manufacturing Purposes. A. Carnegie. Journ. Iron and Steel Institute, 1885.

THE author gives a detailed account of the four gas producing districts near Pittsburg. At the principal field, that of Murraysville, nine wells have been sunk yielding as much as 30,000,000 cubic feet of gas in 24 hours. The wells of Washington County are less productive than those of the Murraysville district, whilst the Butler gas fields and the wells of the Terentum district supply a considerable portion of the gas used. The cost of piping is now estimated, at the present extremely low prices, with right of way at £1500 per mile, the cost of drilling being about £1000. The mode of procedure is described in detail in the original paper. The pressure of the gas as it issues from the mouth of the well is about 200 pounds per square inch. At the works where the gas is used, nine miles from the wells, the pressure is 75 pounds per square inch. Eleven lines of pipe convey gas from the various wells to the manufacturing establishments in and around Pittsburg.

ANALYSES OF NATURAL GAS.

No.	CO_2	CO	O	C_2H_4	C_2H_6	CH_4	H	N	Heat units.
1	0·80	1·00	1·10	0·70	3·60	72·18	20·02	—	728,716
2	0·60	0·80	0·80	0·80	5·50	65·25	26·16	—	698,852
3	—	0·58	0·78	0·98	7·92	60·70	29·03	—	627,170
4	0·40	0·40	0·80	0·60	12·30	49·58	35·92	—	745,813
5	—	1·00	2·10	0·80	5·20	57·85	9·61	23·41	592,380
6	0·30	0·60	1·20	0·60	4·80	75·16	14·45	2·89	745,591

ANALYSES OF SIEMENS' PRODUCER GAS.

No.	CO_2	CO	H	CH_4	N	Heat units.
1	3·90	27·30	—	1·10	67·40	93,966
2	8·60	20·00	8·70	1·20	61·10	97,181
3	9·30	16·50	8·60	2·70	62·90	99,071
4	1·50	23·60	6·00	3·00	65·90	111,939
5	6·10	22·30	28·70	1·00	41·90	164,161

The author has compared the heating power of natural gas with bituminous coal, and found that 54·4 pounds of coal slightly above the general average of Pittsburg coal are equal in heating power to 1000 cubic feet of gas, so that at a cost of five shillings per ton of coal (2000 pounds) 1000 cubic feet of gas are worth for their heat units 1·632 pence. In comparing this gas with anthracite coal, it was found that 1000 cubic feet of gas are equal to 58·4 pounds of coal. If this coal cost 26 shillings per ton, 1000 cubic feet of natural gas are worth nine and a-half pence for heating power.—D. B.

IV.—COLOURING MATTERS AND DYES.

Method for the Manufacture of Azo-colours. Verein Chemischer Fabriken, Mannheim. Ger. Pat. 29,957, February 19, 1884.

TWO molecules of a phenol in an alkaline solution are acted upon with one molecule tetrazoditolyldisulphonic acid. In this manner yellow colouring matters are obtained from phenol, cresol, and xylenol. The naphthols and their sulphonic acids yield red colouring matters, of which those derived from β-naphthol are especially beautiful.—F. M.

Improvements in and relating to the Manufacture of Colouring Matters. William Robert Lake, Southampton Buildings. From Léo Vignon & Co., Lyons, France. Eng. Pat. 6872, April 26, 1884.

THIS invention relates to the production of azo-colours from α-naphtholdisulphonic acid, and the diazo-compounds of amines or their sulphonic acids. The α-naphtholdisulphonic acid is prepared by heating α-naphthol with three times its weight of mono-hydrated sulphuric acid to from 100 to 110° for 8 to 10 hours. A list of the colouring matters produced by the different diazo-compounds is given in the specification; these vary from orange-red to violet-red.—R. M.

Process for Separating the α-monosulpho Acid of the β-naphthol from certain Admixtures. Herbert John Haddan, 67, Strand, Westminster. From the Farbenfabriken vorm. Fr. Bayer & Co., of Elberfeld, Germany. Eng. Pat. 8495, May 31, 1884.

THE object of this invention is to purify the sulphonic acid obtained by rapidly sulphonating β-naphthol at 50-60° from Schäffer's acid, "and another body which is probably also a monosulpho acid of the β-naphthol." The method of separation depends upon the facility with which tetrazodiphenyl and its homologues combine,

first with the "foreign body," then with Schäffer's acid, and lastly with the β-naphthol-α-sulphonic acid. The latter, which is the most valuable product, is required for the crocein scarlet, and by fractional precipitation with tetrazodiphenyl, the "foreign body" and Schäffer's acid are first removed. The advantages claimed for this process are that the by-products which are first precipitated are economically valuable, being valuable claret-red dyes.—R. M.

Improvements in the Process of Manufacturing Chloro-iodic Bases and Colouring Matters. Eugen Ostermayer, Würtemberg; and Max Dittmar, Königsberg. Eng. Pat. 9252, June 20, 1884.

THE bases of the pyridine and quinoline series, when treated in hydrochloric acid solution with iodochloric hydrochloride, form crystalline compounds. In the case of quinoline the substance has the formula C_9H_7NICl. When the neutral aqueous solution is boiled the compound gives off iodine. The following illustrations of the process are given :—(1) 5kilos. of iodine are suspended in 20kilos. of water, and chlorine is introduced till the iodine is dissolved. The solution of ICIHCl is then mixed with a hydrochloric acid solution of 5·2kilos. of quinoline, and the orange-yellow precipitate filtered, washed with water till of a bright sulphur yellow, and then pressed. (2) 5kilos. of KI are dissolved in 5kilos. of water, and 25kilos. HCl added; 4·8kilos. of sodium nitrite are gradually added till a clear solution is formed, when the latter is mixed with 3·85kilos. of quinoline in hydrochloric acid as before. Instead of quinoline and pyridine, their homologues may be employed (toluquinoline, quinaldine, toluquinaldine, etc.), and also the chloromethylates. Examples are given showing the process employed in the case of quinoline-chlormethylate, tetrahydroquinoline-chlormethylate and oxyquinoline-chlormethylate. When these chloriodised bases are heated with aromatic amines (equal molecules of each), red, violet, and blue colouring matters are produced. Thus, with dimethylaniline a blue violet colour is formed. By the addition of benzyl chloride during the reaction the colour obtained is greenish blue.—R. M.

Improvements in the Production of Colouring Matters suitable for Dyeing and Printing. John Erskine, Glasgow. From the Farbenfabriken vormals Friedrich Bayer & Co., Elberfeld. Eng. Pat. 9518, June 28, 1884.

THE new colouring matter described in this specification is a secondary azo compound resulting from the combination of diazoxylene-azobenzenesulphonic acid with β-naphthol-α-sulphonic acid. The formula of the compound is :—

$$\underset{(1)}{SO_3NH_4}.\underset{(4)}{C_6H_4}.N:N.C_8H_8.N:N.C_{10}H_5.\underset{(\beta)}{HO}.\underset{(\alpha)}{NaSO_3}$$

The solution of the diazo-azo compound is mixed with the well-cooled solution of the naphthol sodium salt in the presence of ammonia and the colouring matter salted out.—R. M.

Improvements in the Manufacture of Dye-wood Extracts, etc. Harold Rimmer, Liverpool. Eng. Pat. 9570, June 30, 1884.

THE liquors are concentrated by heat nearly to 10° Tw., reducing the temperature to 80-90° C., and then completing evaporation by the application of air, which is forced through the liquid until the desired strength is attained. For the latter purpose perforated pipes or a rose may be used and supplied by any suitable blowing mechanism or exhauster. "The strength of 10° Tw. can be obtained without discolouring the liquid, but if a temperature of above 80° C. or 90° C. be used for higher concentration, the liquor is liable to be discoloured or 'burnt.'" "By this invention the liquor can be brought to a greater density than can be accomplished by the vacuum process, and the liquor can be concentrated at a higher temperature without the danger of discolouring than by the ordinary open process."—H. A. R.

Improvements in the Manufacture of Dyes or Colouring Stuffs. Emil Capitaine, 89, Chancery Lane, Middlesex. From Adolf Ewer and Paul Pick, of Berlin, Germany. Eng. Pat. 9632, July 1, 1884.

THE object of this invention is to prepare colouring matters varying from yellow to brown by acting with cyanic acid and its derivatives upon primary, secondary, or tertiary amines, or tetra-alkylised derivatives of diamidobenzophenone in the presence of condensing agents. Of the derivatives of cyanic acid the authors specify the ethers, the polymerides and their ethers, the derivatives of urea, and the sulpho-derivatives of cyanic, isocyanic, and cyanuric acids, and the sulpho-derivatives of urea. The condensing agents mentioned are potassium pyrosulphate, meta- and pyrophosphates, phosphorus trichloride, pentachloride and oxychloride, the chlorides and fluorides of boron and silicon, and the chlorides of zinc, magnesium, calcium, and aluminium. Of the colouring matters producible by these reactions the inventors claim only those which, by the action of strong mineral acids, split up into ammonia or a primary aromatic amine, and a tri-, di-, mono-, or non-alkylised diamidobenzophenone. Examples illustrative of the mode of working are given in the specification.—R. M.

Improvements in Producing Sulpho-colouring Matters by Electrolysis. Emil Capitaine, 89, Chancery Lane, Middlesex. From Messrs. Ewer and Pick, Berlin, Germany. Eng. Pat. 9756, July 4, 1884.

THIS invention is based upon the observation that when two plates of platinum are immersed in a solution of paramidodimethylaniline in dilute sulphuric acid, and the solution saturated with sulphuretted hydrogen, the liquid round one of the platinum plates assumes a blue colour when this plate is made the positive and the other plate the negative pole of a voltaic battery or a dynamo-machine. The blue colour formed round the positive plate soon disappears and a grey film collects on the plate; when this film is brushed off the blue colour is again developed, so that if the positive plate is kept clean by constant brushing, the blue colour formed does not disappear, and the colour of the solution becomes deeper as the electrolytic operation proceeds owing to the conversion of the "methylene white" into "methylene blue." In illustration of the mode of working, the inventors describe and figure a form of apparatus which consists of a wooden vat varnished inside, and containing an insulated wooden shaft provided with arms for stirring the liquid, and also with a set of arms provided on their opposite faces with bristles for cleaning the electrodes. The latter are platinised copper plates fixed horizontally in the vat at such a height that they are swept by the brushes on the revolving shaft. A solution of 1 part of paramidodimethylaniline in 40 parts of water and 4 parts of sulphuric acid of 66° B., is first run into the vat, and the stirring apparatus and the electric current started. A solution of sodium sulphide is then run in till the vat liquor is saturated with SH_2. From time to time the liquor is tested for paramidodimethylaniline, and when the substance is no longer present the supply of sodium sulphide is stopped, the excess of SH_2 removed by blowing air through the solution, and the electric current continued till all the "methylene white" has become converted into "methylene blue." The latter is then precipitated by zinc chloride and common salt in the usual way. The process is applicable to other alkylised derivatives of para-diamines, and also to the production of methylene blue directly from nitrosodimethylaniline by first reducing this substance at the negative electrode and then proceeding as before. A form of apparatus for working this last process continuously is described (see this Journal, iv. [5], 310).
—R. M.

Improvements in the Manufacture of Colouring Matter. William Robert Lake, Southampton Buildings, London. From Léo Vignon & Co., Lyons, France. Eng. Pat. 9808, July 5, 1884.

THIS invention relates to the preparation of a yellow colouring matter by nitrating α-naphtholdisulphonic

acid. The latter is prepared by heating 30 parts α-naphthol with 180 parts of sulphuric acid of 66° B. to from 80-100° C. for 8-10 hours. The product is mixed with ice and the diluted solution nitrated by gradually adding 90 parts of nitric acid of 40° B., not allowing the temperature to exceed 30° C. The temperature is afterwards raised to 40° for a few minutes, and then reduced to from 12-15° C., and the precipitate collected, pressed, and converted into a potassium salt. The original feature of the invention is stated to be the employment of the sulphuric acid of 66° B. instead of fuming sulphuric acid. —R. M.

Improvements in the Manufacture of Colouring Matters. William Robert Lake, Southampton Buildings, London. From Léo Vignon & Co., Lyons, France. Eng. Pat. 9812, July 5, 1884.

THE object of this invention is to prepare a series of blue and violet colouring matters containing sulphur from paradiamines produced by the reduction of amidoazo compounds. The process consists of three operations:—(1) The formation of paradiamines by the reduction of the amidoazo compounds by means of sodium sulphide or other reducing agents; (2) The conversion of the paradiamine into a thio-base in the wet way by the prolonged action of sulphuretted hydrogen, or in the dry way by fusion with sulphur according to Lauth's method; (3) The oxidation of the thio-base by means of ferric chloride, potassium bichromate, etc. Amidoazobenzene gives a blue, amidoazotoluene a violet dye, by these operations. The colours are said to be easily applicable to mordanted cotton and to be fast both to light and soap.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Improved Substitute for Gut, applicable to Lawn Tennis and other Rackets; also suitable for Clocks and other Mechanical Purposes. Robert Müller. Eng. Pat. 6446, April 17, 1884.

THE inventor prepares artificial gut by dipping twisted silk cords in a mixture of gelatin and glycerin, the latter being added to give pliability. From 8 to 10 parts of glycerin to 100 parts of gelatin forms a good average mixture. It should be applied at a temperature of 70° C.—E. J. B.

Improvements in the Manufacture of a Combined Paper and Cloth Material for Bookbinding, etc. S. Barlow, Castleton, Manchester. Eng. Pat. 9727, June 3, 1884.

INVENTOR passes the two materials, cloth and paper, through a pair of bowls, one of which has a rigid surface and the other a resilient one. The cloth may be previously stiffened by an ordinary mangle or back-starcher. The adhesive substance used to unite the two materials may be starch, gum, or any other convenient substance. Inventor claims that previous attempts to combine cloth and paper in this manner have been failures, owing to the use of rollers or bowls entirely with rigid surfaces. For rigid bowls he employs brass, copper, hard wood, iron or steel. For the resilient rollers either indiarubber, or metal coated with indiarubber, gutta-percha, cotton, or paper, is employed. The combined material is dried by passing over the steam cylinder as usual, or by any convenient drying process, and may then be calendered, embossed, or finished in any way required.—H. A. R.

Improvements in the Method of and Apparatus for Carbonising and Drying Woollen Pieces, Wool Noils, Waste or Rags. Duke Fox. Eng. Pat. 9273, June 21, 1884.

AN apparatus is employed for treating woollen materials from which it is desired to remove vegetable matter with hot hydrochloric acid gas. The patentee claims "wool or rag carbonisers constructed with a central chamber connected with retorts, the chamber is fitted with a series of swing grids arranged for lowering the material to be operated upon from one grid to another." The specification is accompanied by drawings illustrating the construction of the apparatus.—E. J. B.

An Improved Method or Process of Destroying Vegetable Substances contained in Wool or Woollen Fabrics. George Sales Jarmain. Eng. Pat. 9373, June 24, 1884.

THIS process consists in heating wool or woollen fabrics in a bath of dilute hydrochloric acid. After washing and drying, the material can be readily freed from vegetable matter by mechanical means. The strength of acid and duration of treatment can be varied according to circumstances. With an acid of 1½° Tw., and a temperature of 200° F., about 105 minutes' immersion will suffice at 8° Tw. and a temperature of 180° F.; the treatment should be continued for twenty-six minutes. If the temperature be allowed to rise above 200° F., the woollen material is liable to be affected.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On Printing with Artificial Indigo. H. A. Costobadie Bull. Soc. Ind. Rouen, 1884, 757.

ORTHONITROPHENYLPROPIOLIC acid, which at the time of its appearance attracted a great deal of attention, has now almost fallen into oblivion, most printers having given up using it on account of its high price. Yet, the artificial indigo produced from it possesses certain advantages over the natural product, and for this reason some printers are still using it, especially for light shades. In this case the high price does not form such a great drawback to its application. The treatment of the printed cloth is very simple. It is hung up at a temperature of 25° C. for twelve hours until the blue is fully developed, then soaped at 75° C. and steamed in a Mather & Platt's apparatus. By the process of steaming the disagreeable odour adhering to the cloth (derived from a decomposition product of the xanthate used as a reducing agent) is completely removed. Propiolic acid is also suitable for producing even sky-blue shades by the patting process, upon which discharge patterns can be obtained in the same manner as on vat-blue. Also resist patterns not readily obtainable with natural indigo can be produced with propiolic acid in the manner below described. The mordants thickened with British gum are first printed on the cloth and then dyed up in a colour bath. In order to produce white resist patterns on a blue ground, a mixture containing citric and oxalic acids, and consisting of 96 litres lemon juice 28° B., 24 litres caustic soda 36°, 2 litres oil or tallow, 36kilos. dextrin, and 1·2kilo. oxalic acid, are printed on. After ageing, the cloth is padded with propiolic acid, hung up for twelve hours for the purpose of developing the blue, and passed once more through this process. The standard colour mixture is composed of 3·6kilos. starch, 36 litres water, 31·6kilos. 20 per cent. propiolic acid paste, and 5·5kilos. borax. A printing colour is prepared by adding to 5 litres of this mixture 500 grammes sodium xanthate, a padding colour by mixing 4 litres of this printing mixture with 12 litres of starch paste. The development of the blue being completed, the pieces are passed through a bath of sodium arseniate at 75° C., and then through the colour bath, the temperature of which should be kept as low as possible to avoid deterioration of the blue colour. The pieces are finally soaped at a temperature below 75° C. A resist for chrome yellow and orange is obtained by adding to these colours oxalic acid in the proportion of 15 grammes per litre. Fine orange shades might also be obtained by dyeing up the resist mordant in a nitroalizarin bath. Catechu brown is turned much darker through the influence of the padding colour, this phenomenon being probably due to a peculiar action of the soda xanthate.—F. M.

Effects produced by the Sulphurous Acid of the Atmosphere of Towns. G. Witz. Bull. Soc. Ind. Rouen, **13**, 161.

The author has proved the prevalence of sulphurous anhydride in the atmosphere of the town of Rouen by observations on certain bills printed with lead pigments, chiefly minium, and posted on walls of various aspects. Certain of these which were observed to fade very rapidly were examined, and found to contain both sulphate and sulphite of lead. Bills of the same kind posted along the country roads, although more exposed to the weather, showed a decreasing decolorisation of the printed matter in proportion to the distance from the town. It was also observed that notices printed in the same pigments, and exposed in shop windows where gas was burnt, showed a similar decolorisation, and the presence of sulphite of lead was similarly established. The presence of sulphurous acid in an atmosphere may be readily demonstrated by introducing a glass vessel filled with ice; the humidity condensed on its surface may be tested by the ordinary reagents for this compound. More simply still, the moisture condensed on the windows of a room when gas is being burned will be found to decolourise iodide of starch. The condensation of sulphurous acid together with the moisture in fogs and hoar frosts has been found by the author seriously to affect goods printed with colours sensitive to sulphurous acid; of these he specifies logwood and Brazil wood shades, and aniline black (compare *Ibid.* 1879, 185; 1877, 263; 1876, 310; and 1873, 76). The author especially commends these results and his method of observation to the notice of dyers and calico printers.—C. F. C.

An Improved Apparatus and Process for Bleaching, etc., Fibrous Materials. W. D. Gedge, London. From C. F. Glaser, Berlin. Eng. Pat. 7900, March 19, 1884.

The chief point of this invention is the placing in the interior of the boiling kiers, fitted as required and usual, one or more proportionately light and easily removable vessels, with perforated bottoms, which are charged with the goods to be acted upon; and the arrangement of the space between the inner and outer vessels, by partitions, in such a manner that the agents which are introduced or made to circulate in the boiler may be forced to pass through the materials to be acted upon, and that however high the pressure may be during the operation, the strain on the inner vessel may never exceed that which is necessary for the penetration of the goods.
—H. A. R.

Improvements in Washing and Dyeing Machinery. J. Worrall, Salford. Eng. Pat. 7709, May 14, 1884.

The main feature of this invention is in a washing and dyeing machine, the combination of a tank for containing liquor, with a frame carrying a ring of guide rollers, and two rings of winches or beaters concentric with the rollers, the guide rollers serving to present the fabric, as it is drawn through the machine, to the action of the beaters, such beaters being driven by gearing operated from the central shaft, and serving, while the cloth is presented to the action of the liquor, to impart to the cloth a rapid vibratory motion.—H. A. R.

Improved Apparatus to be used in Bleaching and Dyeing Piece Goods. J. Worrall, Salford. Eng. Pat. 9582, June 30, 1884.

In treating velvets, velveteens and similar goods, great difficulty has hitherto been found in preventing the formation of creases in the goods, which creases are due to the curling up of the selvedges as the fabric is travelling through the bleaching, washing or dye vat. In order to counteract the said curling up, the inventor passes the cloth, during the time of its being acted on by various agents, round a drum surrounded by eight or twelve pressing cylinders, there being fitted between these cylinders, except at the part where the cloth enters and leaves the apparatus, guide bars, tubes or rollers, for holding the cloth away from the drum while it is receiving a supply of bleaching or dyeing liquor. The supply is delivered to the cloth through some or all of the guide bars or tubes, which are slotted for that purpose, and are in communication with a supply cistern or pump. The guide bars, or every alternate one, will be furnished with diagonal ribs, inclining towards a central line, and serving to put a slight lateral strain on the cloth as it passes over the bars, so as to keep the selvedges well extended. For drawings and details the original specification should be consulted.—H. A. R.

Printing one or more Colours simultaneously on Cotton or Woollen Hanks and the like. T. G. Charlesworth, Leicester. Eng. Pat. 9614, July 1, 1884.

The inventor claims the method of dyeing or printing hanks by a sideway passage through the rolls. The method of printing two or more colours simultaneously by a sideway passage through rolls divided into sections, one for each colour, and corresponding divisions in the colour trough, one for each colour, the combination with the colouring rolls of a hank-feeding device consisting of an endless travelling chain with hooks, upon which the hanks are hung. The rolls are covered with felt, rubber, or some similar soft absorbent substance; and one passage through the rolls completes the printing, after which the hanks are dried as usual.—H. A. R.

A New Mode of Dyeing Cotton and other Vegetable Fibres with Insoluble Azo-colouring Matters. Dan Dawson, Huddersfield. Eng. Pat. 9701, July 3, 1884.

The inventor claims that by bringing about a slow and gradual combination of materials used to produce the colour, aided by the "catalytic" action of the cotton when immersed in the bath, the dyeing can be done at one operation. It is proposed to accomplish this by keeping the bath free from mineral acid, and only having a small quantity of a weak organic acid present—*e.g.*, acetic acid. The bath is prepared as follows: A body—*e.g.*, naphthylamine—is diazotised as usual. Strength of solution to be about one per cent. of chloride, and plenty of HCl required present. The bath is neutralised by means of chalk. Then are added finely-precipitated naphthol and acetate of soda, with a little acetic acid. It is claimed that cotton immersed in the above bath will fix the colouring matter as it forms. The fixing of an insoluble soap before dyeing causes the operation to take place more quickly, and deeper shades to be obtaned.—H. A. R.

A New or Improved Bleaching Solution. R. B. Lyth, Belfast. Eng. Pat. 9802, July 5, 1884.

The inventor prepares a bleaching solution by charging a solution of chloride of lime with sufficient carbonated water to precipitate the lime held in solution. It is claimed that a much shorter time is required for bleaching the goods, that less boiling is required, that the application is much safer and turns out the goods stronger, and also that it is cheaper than any other process hitherto applied.—H. A. R.

An Improved Process in Dyeing with Substances containing Tannin, or Tannic Acid, or Gallo-tannic Acid. Henry Grandage and Robert E. Steel, Bradford, Yorkshire. Eng. Pat. 12,490, September 12, 1884.

The invention consists in an improved process of dyeing fibres where tannin or tannic acid is employed, and has for its object the union with the fibre of a larger quantity of tannin or tannic acid from a given solution than can be united by processes at present in use in dyeing. To obtain this result it is proposed to add to the solution containing the tannin itself obtained from myrabolans, sumac, divi-divi, galls, gambier, etc., before employing it for dyeing, one or more of the following salts—viz., sodium chlorate or biborate, potassium chloride, or ammonium chloride. The quantities of the above salts found to give the best results were found to be sodium chloride 10 per cent., borax ½ per cent., potassium

chloride 10 per cent., ammonium chloride 2 per cent. The percentages are calculated on the crude tannins from which the solutions are made. Inventors do not claim as original any process for extracting tannin, but claim as novel and original the adding of certain salts to the tannin solutions in order to cause fibres to assimilate more tannin.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

New Chemical Apparatus for the Recovery of Nitrous Compounds in the Manufacture of Sulphuric Acid. Dingl. Polyt. J. **256**, 125.

For the recovery of the nitrous compounds in the manufacture of sulphuric acid, the Société Anonyme des Produits Chimiques de la Manufacture de Javel, Paris, proposes (Ger. Pat. 30,749, August 12, 1884) to wash the gases previous to their passage into the Gay-Lussac apparatus with a spray of concentrated sulphuric acid, the latter being only intended for retaining those nitrous compounds which have been carried away mechanically. The lead-lined tower A (Figs. 1 and 2) contains a small quantity of coke C upon a grid fixed at a height of about one metre above the bottom, and serving for the distribution of the gases entering by the pipe B. A fine rain of sulphuric acid of 60-62° B. falls from the acid distributors x. The construction of one of these distributors working under the pressure of a column of liquid in the pipe E, three to four metres high, will be understood from the wood-cut (Fig. 3). The small spreading disc a is fixed to one end of the rod b, which passes through the vessel D and is surrounded by the pipe F. The other end of the rod is furnished with a thread, and by means of the nut d fixed upon D. In accordance with the more or less cone-shaped form of a, the liquid which passes through the annular opening of the vessel D falls in a rain of greater or smaller radius.—F. M.

Process for Decomposing the Chlorides and Oxychlorides of Magnesium, Manganese and Chromium. Dingl. Polyt. J. **256**, 125.

For the purpose of decomposing the chlorides and oxychlorides of magnesium, manganese, and chromium, the concentrated solutions of these salts, according to a patent of R. Nithack, Nordhausen (Ger. Pat. May 29, 1884), are in a fine state of division brought into contact with hot bodies. The pipe R (Fig. 4) is connected with the flue F, and serves as a super-heater. A spray producer Z connected with the pressure vessel containing the salt solution is fixed in the wall of the long narrow chamber C. The latter and the larger chamber K, in

Fig 1

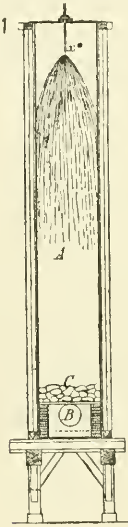


Fig 3.

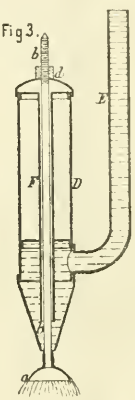
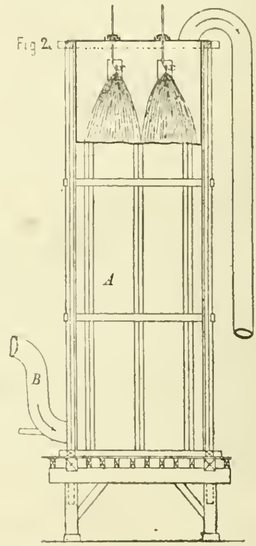


Fig 2.



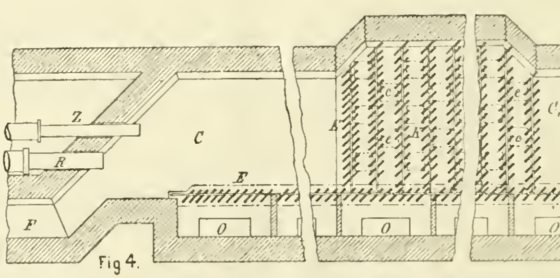


Fig 4.

which rows of fire-clay tiles are set up, are furnished with a kind of false bottom, likewise consisting of slanting tiles, through which the solid masses fall, and can be removed through the openings O or c. The plates E are either fixed or arranged so that the distance between them is adjustable. From the chamber K, the flue C_1 leads into another chamber, and so forth; the gases pass at last through a system of regenerators into the condensers. The method of working this apparatus consists in first heating up the flues and chambers, and then blowing in the solution through the nozzle connected with the spray producer Z. The fine particles of the salt solution coming in contact with the hot air from F and the walls of the chambers are decomposed according to the equations $MgCl_2 + H_2O = MgO + 2HCl$; $2HCl + O = Cl_2 + H_2O$, etc.—F. M.

On the Composition of the Gases produced by the Combustion of Iron Pyrites. M. Scheurer-Kestner. Bull. Soc. Chim. 1885, xliii. p. 9.

THE author has made thirteen more analyses of the gas from Maletra burners. In only one case was sulphuric acid absent. The rest gave results ranging from 0·4 to 9·3 SO_3 per 100 parts of SO_2. There appears to be no connection between the percentages of sulphuric and sulphurous acids present in the burner gases. The acid liquors condensing in the connections leading from the burners generally have a sp. gr. of from 1·6 to 1·689. The author explains the absence of anhydride as such by showing that the moisture in the pyrites and the air consumed, is more than sufficient to hydrate the whole of the sulphuric anhydride formed. The bulk of this anhydride (consequently as sulphuric acid) he supposes is condensed in the Glover tower, which coincides with the fact that the acid used here is observed to increase in its passage from the top to the bottom. It is true Mr. Forster, eleven years ago, gave it as his opinion that this increase was entirely due to the oxidation of sulphurous acid by the nitrous acid from the Gay-Lussac; but as Mr. Forster's burner gases seem to have contained no sulphuric anhydride, and as his Glover tower was of a very low concentrating power, the author cannot regard this as a refutation of his opinion, the more especially as Mr. Forster's own calculations show a deficiency of sulphurous acid *leaving* the Glover; and the manner in which his experiments were made leaves it open to question whether this deficiency was not even greater than stated. Experiments extending over sixteen days showed that from fifteen to twenty per cent. of the total acid produced were condensed in the Glover tower. This may be supposed to include both the sulphuric anhydride proved by the author to exist in the burner gases, and the sulphuric acid formed in the Glover itself by the action of the nitrogen compounds upon the sulphurous gas, as stated by Mr. Forster.—A. R. D.

Improvements in Apparatus to be employed in the Production of Carbonate and Bicarbonate of Soda from Sulphate of Soda, or from Chloride of Sodium. Holbrook Gaskell and Ferdinand Hurter. Eng. Pat. 8804, June 10, 1884.

THIS apparatus consists of arrangements for preparing solutions of sodium sulphate, and of apparatus for saturating such solutions with ammonia and carbonic acid gas—viz., a series of cylinders, through which the ammoniacal solution of sodium sulphate and carbonic acid gas under pressure, flow in opposite directions. —F. H.

Improvements in the Manufacture of Chlorine. Thomas Macfarlane. Eng. Pat. 9234, June 20, 1884.

DRY manganese protochloride, obtained by evaporation of residual solutions of the manufacture of chlorine, is ground and mixed with from one to four times its weight of dry ferric oxide. The mixture is heated in a muffle furnace to about 400° C., and dry air passed over it. The air is dried by means of calcium chloride. The manganous chloride is decomposed, manganese sesqui and dioxide are formed, and chlorine gas evolved. The chlorine diluted by nitrogen, and containing some hydrochloric acid, is cooled, washed and absorbed by lime to produce bleaching powder. The mixture of manganic oxides and ferric oxide is treated with hydrochloric acid, which attacks the manganic oxides, whereby chlorine is liberated, while the ferric oxide remains for the most part unchanged. The mixture of solution of manganous chloride with ferric oxide is evaporated to dryness, and the dry residue is heated as above described. This round of operations may be continued indefinitely.—F. H.

Improvements in obtaining partly in the Free State and partly as Vapour of Hydrochloric Acid, the Chlorine of the Chloride of Magnesium of Aqueous Solutions of Chloride of Magnesium, or of Mixed Solutions of Chloride of Magnesium and Chloride of Sodium. Walter Weldon. Partly from A. R. Pechiney & Co., Salindres. Eng. Pat. 9306, June 23, 1884.

SOLUTIONS of magnesium chloride, which may contain sodium chloride (such as are obtained by decomposing by magnesia the ammonium chloride contained in certain residual solutions of the manufacture of soda by the ammonia process), are concentrated by evaporation as far as can be done without evolution of hydrochloric acid. Sodium chloride salts out, and is removed by fishing. To the boiling concentrated solution of magnesium chloride is added, and intimately mixed therewith, from one-half to one and one-half equivalents of magnesia, such as results from a subsequent operation. A solid hydrated magnesium oxychloride is thus obtained. This oxychloride is first desiccated at a comparatively low temperature (150° to 300° C.). The water, together with a small quantity of hydrochloric acid, are driven off. The desiccated oxychloride is then further heated in contact with a current of air (preferably in apparatus as described in Eng. Pat. 9304, 1884). The chlorine of the oxychloride is thereby driven off, partly as free chlorine, partly as hydrochloric acid. The latter is condensed, and the chlorine then utilised. The resulting magnesia is used in part as above described.—F. H.

Improvements in the Manufacture of Chlorine and Hydrochloric Acid. Walter Weldon. From A. R. Pechiney & Co., Salindres, France. Eng. Pat. 9307, June 23, 1884.

MAGNESIUM chloride containing water is first heated in vessels resembling retorts or muffle furnaces, with little or no access of air, to a temperature at which the water reacts upon the magnesium chloride, yielding magnesia and hydrochloric acid, which is condensed. The resulting mixture of magnesium chloride and magnesia is then heated in a current of air. The chlorine contained in the solid residue of the first operation is thus driven off, partly as hydrochloric acid, but largely as free chlorine. The two operations may be carried out in two distinct pieces of apparatus, or in one single apparatus, for which that described in Eng. Pat. 9304, 1884, is recommended. —F. H.

Improvements in the Manufacture of Sulphite of Soda. Eustace Carey and Holbrook Gaskell the younger. Eng. Pat. 9458, June 26, 1884.

MONOHYDRATED sodium carbonate, either pure or in the crude state (salts), according to the desired purity of the product, is exposed to the action of sulphurous anhydride so long until sufficient sulphurous anhydride is absorbed to correspond to a neutral sulphite. The product contains sodium bicarbonate. The monohydrated sodium carbonate is exposed in revolving cylinders, through the hollow axles of which the sulphurous anhydride enters, and the carbonic acid together with inert gases leave. Several cylinders are employed in series if the sulphurous anhydride is obtained by combustion in air of brimstone or pyrites. If wet, the sulphurous anhydride must be dried by means of sulphuric acid.—F. H.

Improvements in the Manufacture of Chlorine and Hydrochloric Acid from Chloride of Magnesium. Walter Weldon. From Pechiney & Co., Salindres. Eng. Pat. 9688, July 2, 1884.

SOLID hydrated magnesium chloride, whether crystallised or not, is first heated to a temperature of from 150° to 200° C. By this operation the water can be reduced to about two equivalents, without the evolution of more than a very small proportion of the chlorine (chiefly in form of hydrochloric acid). The partially dehydrated magnesium chloride is then heated to a higher temperature in contact with air. Vapour of hydrochloric acid and free chlorine is evolved; but the latter in much greater proportion than would have been the case if the previous dehydration at lower temperatures had been omitted. The dehydration is carried out by passing over the solid hydrated magnesium chloride air or gases previously heated to the requisite temperature. The dehydrated magnesium chloride is heated in muffle furnaces, or in apparatus described in Eng. Pat. 9304, June 23, 1884.—F. H.

Method for the Manufacture of Sulphur from Sulphuretted Hydrogen. Oesterreichische Soda-Fabrik, Hruschau. Ger. Pat. 30,746, July 26, 1884.

THE sulphuretted hydrogen is passed over heated sulphates of alkalis or alkaline earths, whereby the oxygen of these salts decomposes the sulphuretted hydrogen, a sulphide and free sulphur being formed. By the action of atmospheric air upon the sulphide, sulphate is regenerated, which may again be used in the process.—F. M.

Improvements in the Methods of obtaining Ammonia and Hydrochloric Acid in the Manufacture of Soda from Sodium Chloride by the Ammonia Process. A. M'Dougall, Penrith. Eng. Pat. 2048, Feb. 10, 1885.

THIS invention consists of the substitution of magnesia for lime in the decomposition of the ammonium-chloride formed in the ammonia-soda process. Rather more than an equivalent of magnesia is added to the ammonium chloride in a suitable still, and heat applied till all the ammonia is liberated. A further heat, aided towards the end of the operation by stirring, and the introduction of a steam jet, now drives off the hydrochloric acid, which may be recovered in any suitable way, while the magnesia is left ready to be used over again.—A. R. D.

An Improved Method of treating Ammonium-chloride. W. P. Cochrane, Redcar; and W. Bramley, Middlesbro'. Eng. Pat. 11,222, March 14, 1885.

FROM the residual liquors of the ammonia-soda process, the small proportion of sodium chloride present is eliminated by "fishing." To the remaining solution of ammonium chloride magnesia is added in the proportion of rather more than two molecules for every two molecules of ammonium chloride present. On the application of heat the ammonia is readily liberated, especially if the mixture be stirred and kept at the consistency of milk of lime. The residual liquor contains magnesium oxychloride, which may be recovered by evaporation and used for the production of free chlorine, hydrochloric acid, and magnesia.—A. R. D.

Improvements in the Manufacture of Salt, and an Improved System and Apparatus employed therein. J. E. Higgin and T. H. Higgin, Liverpool. Eng. Pat. 9179, March 16, 1885.

THE evaporating pan is supported on pillars, and the space beneath it is enclosed with brickwork sides and ends. The floor slopes upwards towards the back. In front is a row of fireplaces with tightly-fitting doors, and provided, instead of firebars, with perforated iron plates—the holes being ⅝ of an inch in diameter. Extending the length of the fireplaces is an air main having a branch delivering beneath the fire-bearing plates of each fireplace. Air in quantity more than sufficient for the combustion of the fuel is blown or injected through the main into the fireplaces, and so passes along the enclosed space under the pan. After it emerges from the other end of this it is caused to circulate through an air-heater consisting of a series of pipes through which the fresh supply of air needed by the process is drawn by the blower. The advantages claimed are economy in fuel, and a superior quality of salt, with fewer impurities. —A. R. D.

Improvements in Apparatus for the Manufacture of Vinegar. W. H. Perry and J. O. Boulton, both of Nottingham. Eng. Pat. 9997, April 8, 1885.

THIS invention refers to apparatus in which the wash or liquid from which the vinegar is made is passed over beech or other wood shavings in presence of a current of air. Three casks are set at different heights, one above the other. The middle one, called the acetifier, is larger than the others, and has a false bottom of perforated wood or of wickerwork. On this false bottom are piled wood shavings to a suitable height. Above these is fitted a false top forming a kind of shallow well with the sides of the cask. This false top is drilled with small holes so that the liquor it contains may be well distributed over the shavings. Air-holes between the true and false bottoms, and higher up in the sides of the cask, provide for a constant current of air. The topmost cask supplies the liquor to the acetifier. A pipe from its lower portion dips into the shallow well above described, while another pipe from its top does the same, but does not go quite so deep. This latter is an air-pipe, and regulates the flow from the former. If its end is sealed in the well, the supply-pipe ceases to deliver; if, however, this end is unsealed, the supply-pipe delivers till it is sealed again, and so a constant depth of liquor is maintained in the well. The lowest cask is simply a receiver. It may be made interchangeable with the supply cask.—A. R. D.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Improvements in Coating or Surfacing Bricks and Tiles. H. M. Smith, London. Eng. Pat. 9887, July 8, 1884.

THIS invention has for its object the application of a vitreous face or coating to an ordinary brick or tile. The brick in the green state is dipped in a "slip" of the vitreous material, or such faces as it is desired to treat are similarly treated, and the whole is fired in the usual manner. Another manner of securing the object of the invention is to apply the coating in the mould in which the brick or tile is pressed. The vitrified faces may or may not be glazed in the usual manner after the process of vitrification. The claim is for the process as described. —C. C. H.

Improvements in Colouring Stones for Buildings and other Purposes. L. E. A. E. D. De-Liebhaber, London. Eng. Pat. 9888, July 8, 1884.

THE object of this invention is to change the colour of the stones used in building without the introduction of any fresh colouring matter, and particularly to impart a red or brown colour. The stone of the ordinary description used in building, such as Bath stone, etc., is heated to, or above, the temperature of melting lead, and this can be conveniently carried into effect by immersing the stone in a bath of melted lead, the melting point of which can be lowered or raised by the introduction of tin or zinc.—C. C. H.

Improvements in the Means of accelerating the Setting and Hardening of Cements. W. Millar and C. F. Nichols, London. Eng. Pat. 2886, March 4, 1885.

IN place of the water usually mixed with cements or concretes to render them plastic, the inventors add aqueous solutions of certain chemicals, which have the effect of (1) accelerating the setting properties of

cement; (2) indurating it, or increasing its natural hardening properties; "and (3) acting upon the cement or concrete, when set, in such a manner as to enable the mass to be handled in from one hour upwards." The ingredients used for accelerating the setting of cements are sodium carbonate, alum and ammonium carbonate; for indurating or increasing the hardening properties of cements, calcium chloride, magnesia and magnesium chloride; and for obtaining an intense hardness, magnesium oxychloride. As an after process for further indurating cements, "silicon, boron, or some combination of these two chemicals with bichromate of potash" may be used.—E. G. C.

X.—METALLURGY, MINING, Etc.

Treatment of Slag and Phosphates. A. Frank, Charlottenburg, Prussia. Eng. Pat. 7059, April 30, 1884.

Molten liquid slag, or finely-divided solid slag, is treated with magnesium chloride solution, by which the sulphides are decomposed, hydrogen sulphide being produced; also free lime, if present, forms calcium chloride and magnesia, and thus indirectly produces a concentration and greater solubility of the phosphates contained in the slag. The powdery slag, with the adhering magnesium chloride, is further heated by an oxidising flame, and thus lower oxides of iron and the like are partly oxidised, in consequence of which the oxides become less soluble in acids. The same method is applicable for the cleansing and concentrating of natural or artificial phosphates, especially such as contain lime uncombined with phosphoric acid. If such phosphates contain carbonate of lime, the latter must be rendered caustic by burning.—J. T.

Extraction of Dangerous Compounds of Lead, Arsenic, etc. W. H. Tooth and J. E. Rooker, London. Eng. Pat. 7977, May 20, 1884.

The object of the invention is to remove volatile compounds in such a manner as not to be injurious to the workmen. The ore, etc., is heated in a retort connected with a series of condensing pipes, which are partially exhausted by means of a steam jet. Superheated steam or air may be passed into the retort.—J. T.

Utilising Phosphoric Slag. E. Capitaine, London. Eng. Pat. 8890, June 12, 1884.

The author finds that phosphoric slag liberates ammonia from ammoniacal salts in the form of gas, just as lime does. This discovery he utilises by using phosphoric slag in the place of lime in the ammonia-soda industry, and in all cases where lime may be used for the liberation of ammonia. The slag is used in the raw state; it is advisable to break it into small pieces, but during the process the pieces become completely disintegrated. When the slag is so exhausted as not to expel any more ammonia, the excess of bases that it contains passes into solution as salts corresponding to the ammoniacal salts. The residual slag still contains the whole of the phosphoric acid. The further treatment of this enriched material offers no difficulty.—J. T.

Separation of Ores and Mineral Products. F. J. King, London. Eng. Pat. 15,027, November 14, 1884.

This invention relates to the separation of substances which are partially magnetic, or have been made so by previous treatment. These substances are passed underneath a cylinder of iron bars, which are alternately magnetised and demagnetised, by which the magnetic material is removed from the non-magnetic.—J. T.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Method for the Purification of Mineral Oils. C. Roth, Berlin. Ger. Pat. 30,786, June 17, 1884.

In order to free mineral oils from substances which are liable to resinify so as to make them suitable for lubricating purposes, etc., from 1 to 5 per cent. of potassium permanganate are added previous to the process of distillation, which is conducted slowly. The distillate is first treated with sulphuric acid of 1·53 to 1·6 sp. gr., and then with caustic soda of 1·4 sp. gr. The treatment with potassium permanganate, sulphuric acid and caustic soda is once repeated. Mineral oil purified in this manner possesses a slightly yellow colour, with a green fluorescence, and after three days' exposure to air at 35° C. exhibits but slight signs of the formation of resinous bodies.—F. M.

Improvements in Cooling Apparatus for Cooling Oleine and other Liquids. A. Kind, Venice. Per W. P. Thompson & Co. Eng. Pat. 9072, July 2, 1884.

By means of suitable machinery and an arrangement of concentric cylinders, the liquid to be cooled, and the refrigerating medium, are made to move in opposite directions on either side of a partition, to which ribs are attached in order to increase the length of path travelled by the liquid to be cooled. Drawings are given.—W. L. C.

Improvements in the Process of Extracting Fat from, and drying Bones and the like. F. Seltsam, Bavaria. Per W. P. Thompson. Eng. Pat. 10,208, July 16, 1884.

In the ordinary extraction processes, difficulties arise from the presence of water in the bones. The patentee proposes to overcome these by the use of a solvent (usually a hydrocarbon from petroleum, etc.), the boiling point of which considerably exceeds that of water. The temperature in the extraction being raised by steam above 100° C., the water is expelled from the bones, and the extraction of the fat is more complete. The quality of the gelatin and crushed bones ultimately produced is said to be much improved.—W. L. C.

Improvements in the Manufacture of Soap and Saponaceous Compounds. S. N. Dimbleby. Per Tongue and Birkbeck. Eng. Pat. 11,305, August 15, 1884.

The juice of the plant *Hamamelis Virginica*, or common Wych Hazel, is mixed with soap, and with various compounds for toilet purposes which contain soap. Such compounds are said to be beneficial in the case of bruises and lacerations of the skin.—W. L. C.

An Improved Process for Extracting Oil and Albumenoid from Maize and other Grains. Dr. F. V. Greene, Philadelphia, U.S.A. Per Allison Bros. Eng. Pat. 3101, March 10, 1885.

The so-called "starch milk," which is a by-product in starch manufacture, contains an emulsion of oil and of the albumenoid matter of the grain. The patentee proposes to separate these substances from the water, rendering the latter innocuous, and producing valuable substances. Various methods are proposed—filtration, precipitation by various salts and acids, but notably by sulphate of alumina. From the mixed products, partly dried, the oil is separated by a solvent, and the albumenoids are used as fertilisers. The method is also applicable to the residues left after distilling spirit from corn.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Compositions for Protecting Iron Surfaces from Damp and Corrosion. J. Brydson, Kingston-on-Hull. Eng. Pat. 9105, June 17, 1884.

Three compositions are applied to the surface to be protected, which is first cleared from rust and scale. The first composition used is a varnish consisting of linseed oil, magnesia, sugar of lead, and litharge, heated and mixed while hot with a solution of resin in turpentine. After the mixture has cooled, zinc oxide and

calcium hydrate are added, and the whole is allowed to stand for several days before use. The next composition is a liquid gum consisting of alcohol, copal gum, dragons' blood, sugar of lead, beeswax, and turpentine; and the final composition consists of carefully-sifted wood powder, calcined wood powder, and umber, made up with water and calcium hydrate, and stove-dried. This can be at once applied over the gum, and the surface will then be ready for receiving paint or other decoration.
—E. G. C.

XIV.—AGRICULTURE, MANURES, Etc.

Influence of Certain Salts on Nitrification. P. Pichard. Bied. Centr. **14**, 152-156.

The experiments were made on coarse and on fine sand of the composition here indicated, mixed with earth-nut cake, in quantities such as to give N = 0·15 per cent. of the mixture.

	Soluble in Aqua Regia.				Insoluble.
	Fe_2O_3 and Al_2O_3	CaO	MgO	K_2O	
Coarse sand	1·300%	0·068%	0·025%	0·007%	98·600%
Fine sand...	0·100	0·050	0·020	0·005	98·825

	Total N	Nitric N	K_2O	Total Ash.
Earth-nut cake...	7·700%...	0·029%...	1·250%...	4·400%

Each of the following salts were added to separate portions of this mixture in quantities approximating to the actual proportion generally found in soils. The salts employed were the carbonates and sulphates of potassium, sodium, calcium, and magnesium. In two cases no salts were added, and in two other experiments the earth-nut was replaced by ammonium sulphate on coarse sand, mixed with calcium and magnesium carbonate respectively. These mixtures were made up on the 30th May, 1883; they were placed in glass vases, with a layer of glass fragments below and a layer of pure sand on the top; they were kept moistened with distilled water, and were sheltered from rain and dust. On August 30 slight nitrification had taken place in the ammonium sulphate mixtures, but not in those containing earth-nut. The author attributes this formation of nitric acid to simple atmospheric oxidation. On August 31, to start nitrification, each mixture was seeded by the addition of about 0·75 per cent. of soil. At the close of the experiments, March 15, 1884, the mixtures were heated to 70° to arrest nitrifying activity, and were then analysed, the quantity of nitric acid being estimated by Boussingault's indigo method. In the coarse sand series the percentages of the total nitrogen nitrified were as follows:—In the mixture containing potassium carbonate 4·96, sodium carbonate 2·14, calcium carbonate 26·15, magnesium carbonate 24·47, potassium sulphate 12·59, sodium sulphate 15·61, calcium sulphate 28·82, magnesium sulphate 3·94, and where there was no salt added, 3·54; whilst in the fine sand the corresponding percentages of total nitrogen nitrified were potassium sulphate 20·86, sodium sulphate 24·96, calcium sulphate 46·29, magnesium sulphate 11·55, and with no salt added, 4·86. In the mixtures containing ammonium sulphate the percentage of nitrogen nitrified was with calcium carbonate 3·86, and with magnesium carbonate 3·18; in both these cases the remainder of the ammonia had disappeared, presumedly by volatilisation as carbonate. With regard to the adaptability of the salts for aiding nitrification, the author arranges them in order of merit indicated by the above analytical numbers, heading the list with gypsum. He explains the special activity of the latter substance by the supposition that in the presence of organic matter it is readily reduced, then by contact with air is re-oxidised, and in this manner acting as a conveyer of oxygen it aids nitrification.—D. A. L.

Loss of Nitrogen during Fermentation of Farmyard Manure. H. Joulie. Bied. Centr. **14**, 158-163.

Six mixtures of 75grms. of chopped straw and 50grms. of dry powdered horse droppings were taken and soaked with 300cc. putrid human urine, and 275cc. of water; the solid materials contained in a suitable glass vessel were supported on iron wire-gauze; the liquid filtering through was poured over the mixtures every two or three days. No. 1 received nothing in addition, No. 2 received 10grms. phosphorite, No. 3 10grms. phosphorite and 10grms. gypsum, No. 4 10grms. phosphorite and 10grms. calcium carbonate, No. 5 10grms. of calcium carbonate, No. 6 10grms. gypsum, whilst a 7th mixture was composed as follows: 150grms. straw, 200grms. horse excrement, 400cc. urine, and 850cc. water. After 6½ months there were only traces of humic acid found in Nos. 3 and 6; 0·92 to 0·96 per cent. of the organic substance employed in Nos. 2, 4 and 5, whilst Nos. 1 and 7 contain 1·3 to 1·4 per cent. Complete analyses of mixtures 1 and 7 showed the manures were similar to fermented farmyard manure, allowing for difference caused by use of human urine instead of that of cattle. The losses of solid matter per cent. in each case were as follows:—

Mixture	1.	2.	3.	4.	5.	6.	7.
Losses ...	53·71	57·92	49·74	56·35	58·00	52·61	56·20

Whilst the losses per cent. of nitrogen are indicated by the following analytical data:—

Mixture	1.	2.	3.	4.	5.	6.	7.
Losses......	18·04	21·08	39·00	31·27	40·60	33·98	21·26

These numbers were obtained by analysis of both the liquid and solid matter; nitrogen as ammonia, as nitric acid, and in organic combination being estimated in all cases. In all cases there was a large decrease in ammoniacal nitrogen, ranging from 50 to 85 per cent.; and a large increase in organic nitrogen, from 35 to 63 per cent. On the other hand, the nitrogen as nitric acid only appeared, and then only in small quantities, in the mixtures 3 and 6, where gypsum had been added, which mixtures, it will also be observed, were almost free from humic acids. Apparently, then, much of the ammoniacal nitrogen is rendered insoluble by becoming organic, whilst much of it is lost. This is shown below:—

NITROGEN AS AMMONIA, PER CENT. OF THAT INTRODUCED.

Mixture	1.	2.	3.	4.	5.	6.	7.
Disappeared...	49·96	49·47	71·43	61·40	70·41	67·34	85·30
Transformed..	24·82	20·09	11·09	17·83	13·84	19·98	44·54
Lost..............	25·14	29·38	54·34	43·57	56·57	47·36	40·76

This loss of ammoniacal nitrogen would probably be larger in the great heaps in the farmyard, where the temperature much exceeds that obtained in these experiments; this is indicated by the greater loss in No. 7, where the composition was similar, but the mass and surface exposed were greater than in mixture 1. The loss is probably by volatilisation as ammonium carbonate, or perhaps fermentative. It is evident that gypsum and chalk, either alone or otherwise, increase the loss of nitrogen considerably.—D. A. L.

Presence of Amylase in Leaves. L. Brasse. Bied. Centr. **14**, 169-170.

The author has found amylase in all leaves he examined, including potato, dahlia, maize, turnip, tobacco, castor-oil plant, etc.; also in poppy, pink, sun-flower, and castor-oil seeds. It was extracted by Dubrunfaut's method. The leaves or seeds were bruised in a mortar, macerated for twenty-four hours in cold water, pressed, and the solution mixed with one-and-a-half times its volume of 90 to 93° alcohol and filtered. A similar quantity of alcohol was added to the filtrate, and the precipitate which contains the amylase was collected on a filter and washed with 65° alcohol. To prove the presence of the amylase in the precipitate, 0·5grm. starch, 20cc. water, and 10cc. of an aqueous solution of the amylase, which

quantity corresponded to 10grms. of fresh leaves, were placed in small flasks, and along with other flasks, containing the amylase solution alone, were kept in a water bath at a temperature of 63°, and the reducing sugar estimated by difference. Eight to ten drops of chloroform were added to each flask, and they were then closed with corks. Microbes were not detected in the solutions; in all cases the starch was converted into a reducing sugar and dextrin.—D. A. L.

Poisonous Effects of Arsenic, Lead and Zinc on Vegetable Organisms. F. Nobbe, P. Baessler, and H. Will. Bied. Centr. **14**, 175-183.

Young and healthy growing plants were introduced into nutritive solutions to which varying quantities of potassium arsenite had been added; in many of the experiments the quantity of arsenic added in this form amounted to 0·003, 0·033, 0·333, and 1·0grm. per litre. In all cases control cultivations were conducted with similar plants without arsenic. With the arsenic the plant withers and fades, the older leaves first, then the stem; it then recovers slightly, especially if removed to a fresh non-poisonous solution, but only to sink again and finally perish. The rapidity of this poisonous action increases with the strength of the arsenic solutions, but it also depends to some extent on the kind of plant. Peas and oats succumb quicker than maize and shrubs. Following the order of strengths given above, peas perish either in twelve, four or three days respectively. The quantity of arsenic taken up by the plant is very minute. The roots always contain more than the other parts of the plant. Many other experiments tend to show that the root is the vulnerable point; for instance, comparative arsenic cultivations were conducted in the dark in moist atmospheres, and in the light in the ordinary atmosphere. In the former case the action of the arsenic was retarded,—showing, firstly, that the roots were attacked more than the above-ground growth; and, secondly, that the transpiration or absorption faculty was effected in some way. The following experiment illustrates the latter effect:—Young alder plants were set in solutions containing 0·0003 arsenic per litre, and observations of transpiration and absorption were made every two hours during the day. After the first two hours the plant had only absorbed 40 per cent. of the normal quantity of water, and throughout the experiment the transpiration almost always exceeded the absorption, hence the plant lost in weight, and after three days, when the plant was almost dead and the experiment ended, this loss amounted to 19·2 per cent. When analysed in this condition, the dry matter of the root contained 0·008 per cent. arsenic, whilst the other part of the plant contained only 0·0029 per cent. Solutions containing only one per million of arsenic are still injuriously active, and the harmless limit of dilution has not yet been reached. The arsenic apparently attacks the protoplasm of the roots, impeding their osmotic action, and consequently diminishing the quantity of water absorbed. Similar experiments with lead and zinc demonstrate that these metals are extremely injurious to plants, whether presented in a soluble form as nitrates or in an insoluble form as carbonates; even if they are present in such small quantities that the plant appears healthy externally, their deleterious action is evident in the diminished yield of the plant. Zinc is more poisonous even in form of carbonate, than lead, and is also taken up by the plant in much greater quantities than the latter metal is. Solutions containing one-thousandth part of zinc kill plants (peas) in three days, whilst solutions of lead containing similar quantities produced a similar effect in eleven days. (See Action of Zinc Salts on Plants, this Journal, iv. [6], 408).
—D. A. L.

Detection of Fungoid Spores and Putrefaction Germs in Cattle Foods. A. Emmerling. Bied. Centr. **14**, 212-213.

Small quantities of the materials made into a thin magma with water are introduced into clean glass tubes, using all necessary precautions against the introduction of foreign organisms. After being heated for twenty-four hours at 35° C., the contents of the tubes are examined microscopically. This method, when worked with care, has been found to give concordant results, and is therefore regarded as satisfactory for the detection of mould-spores, etc. Samples of sesame cake and earth-nut meal were found to be free from fungoid-spores, whereas rice meal was found full of them. With regard to bacteria, sesame cake contained bacilli and sometimes mycoderma; and earth-nut cake and rice meal, micrococci and bacilli.—D. A. L.

Improvements in the Treatment of the Lupinus (Lupine) to adapt it for use for Cattle. Emil Capitaine, London. Eng. Pat. 10,495, July 23, 1884.

The object of this invention is to extract from the lupinus the bitter principle which renders it unsuitable for use as a cattle food, without at the same time impairing its nourishing properties. The plants are first kiln-dried at a temperature not exceeding 70° C., and then placed in water at a temperature ranging between 65° and 85° C. If the temperature be lower than 65°, part of the albumen is dissolved and lost for feeding purposes; if higher than 85°, a considerable portion of the proteïd matter is rendered insoluble.
—E. G. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Position of Sorghum Saccharatum in Agriculture and the Sugar Factory. E. Szechenyi, jun. Bied. Centr. **14**, 186.

Minnesota amber-cane (sugar-cane) was cultivated in Hungary, and the produce treated for sugar in the American fashion. When the seed was sown before the end of April, the plants developed to complete ripeness, but seeds sown later did not ripen. The yield per joch was 115·7metr.centr. of canes, 14·65 of seeds and stalks, 6·60 of cane-leaves. The 115·7metr.centr. of cane gave 34·55 of green sap; and the syrup obtained from the sap by means of milk of lime, etc., when concentrated contained per cent. cane-sugar 52·10, invert sugar 28·62, water 15·74, ash 1·95, non-saccharine matter 1·50, which by centrifugalising yielded a brown cane-sugar containing over 80 per cent. of crystalline sugar. The dried seeds and stalk had the following composition (water 14·3%):—

Fat.	Albumenoids.	Non-nitrogenous nutritives.	Woody fibre.	Ash.	Sand.	
3·25	11·20	80·25	3·25	1·95	0·10	= 100

—approximating to that of barley. The pressed canes when fresh are eaten by cattle, but not by sheep; when treated otherwise, cattle will not consume them without they are previously mixed and warmed with chaff, straw, and water. According to the author, sorghum is not an exhausting plot for the soil.—D. A. L.

Extracting Sugar from Molasses and Saccharine Solutions. Jünemann. Bied. Centr. **14**, 216.

For this purpose the author recommends the use of a certain soluble magnesium hydroxide; it forms an insoluble magnesium saccharate, which, when decomposed with carbonic anhydride, yields pure sugar. The mode of preparing the hydroxide is not given.—D. A. L.

Improvements in Purifying or Clarifying Sugar, and in Apparatus therefor. Eugen Langen, London. Eng. Pat. 10,367, July 19, 1884.

This invention relates to the process of purifying sugar by washing out the molasses from the crystallised sugar by means of pure syrup. It differs, however, from the ordinary process in that it is continuous, the sugar being made to traverse the apparatus in one direction, whilst the syrup with which it is washed moves in the opposite

direction. Hence the pure syrup comes into contact with nearly pure sugar, and, as it becomes more and more impure, it meets also with less pure sugar. Special apparatus in which to carry on the operation is described. —A. J. K.

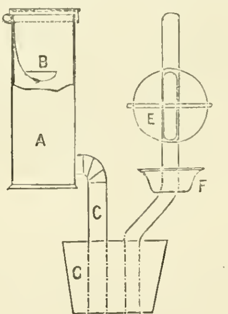
XVI.—BREWING, WINES, SPIRITS, Etc.

Cultivated Wine Yeast. A. Rommier. Bied. Centr. **14**, 203-204.

In previous communications the author has shown that the addition of cultivated wine yeast to must from different varieties of grapes accelerates fermentation at relatively low temperatures, and produces wine quicker than the natural fermentation would do; moreover, the cultivated wine yeasts, without previous sterilisation of the must, prevents secondary fermentation, which would spoil the wine. The present experiments were conducted during warm weather, hence the accelerating effect was not observed; anyway, the yeast prevented the development of deleterious germs, therefore it exerts a preservative influence on the wine, and in cold weather increases the rapidity and regularity of fermentation. —D. A. L.

Apparatus for the Treatment of Wine with Sulphurous Acid. J. Nessler, Carlsruhe. Ger Pat. 29,590, May 13, 1884.

The cylindrical vessel A, made of tin plate and lacquered, contains an iron spoon B, and is furnished with a pipe C. When in use the apparatus is by means of the cork G fixed upon the vessel in which the sulphurous acid is to act. Some spirit is then poured into the copper vessel F (partly filled with sand or asbestos) and set on fire; the sulphur contained in the spoon B is, after previous heating of the latter, likewise set on fire and again put into A.



The air in the ball E is heated by the burning spirit, and thus causes a draught, which supplies the sulphur with air and causes the sulphurous acid to pass into the vessel where it is wanted. In this manner sulphurous acid can be used for killing the mould and mycoderma-vini or -aceti plants in an empty or partly full cask, in which otherwise the sulphur would not burn.—F. M.

Improvements in Making an Extract and Beverages from Clover. J. Walker, Leeds. Eng. Pat. 8916, June 13, 1884.

The dried clover is chopped and mashed in water; the extract so obtained is boiled with hops, and the liquor therefrom treated with citric, tartaric, or acetic acid, afterwards with a little carbonate of soda to neutralise the excess of acid, and then fined and filtered. The golden-coloured liquid so obtained is made into a syrup with sugar, and may then be used for the production of an aërated or non-aërated beverage, or used to flavour other liquors. It may also be added to malt worts previous to fermentation, producing a beer of a fuller character and less intoxicating. It is also valuable as an anti scorbutic.—C. C. H.

A Process for the Continuous Distillation and Rectification of Alcohols, or other Volatile Substances, and Apparatus for the Purpose. J. C. Mewburn, London. From E. A. Barbet, Nord, France. Eng. Pat. 9397, June 25, 1884.

The improved process involves the employment of a distilling column or purifier in which the ethers are separated first from the alcoholic solution, and a rectifier in which the alcohol obtained in the purifier is further submitted to distillation. Both columns resemble each other in construction, and differ only in proportion of parts. The liquid undergoing distillation is first heated in the lower part of the column by the heat of the condensed material running from the column, and is then introduced into the column at the top, and in its descent undergoes fractionation, the ether condensing and collecting at the bottom, whence it runs to a receiver, and the alcohol passing to a condenser, and from thence to the second column, where it is similarly treated to the liquid in the first column. The process of distillation is therefore continuous with the operation of rectification. The interior of each column is fitted with shelves and cups, in a manner similar to the shelves usual in stills. The claims are: (1) for the process of continuous distillation, (2) for the apparatus, (3) a specially constructed shelf and cup.—C. C. H.

An Improved Method of Converting the Juice of the Jerusalem Artichoke into Levulose, and the Application of the latter for Obtaining Various Products by Fermentation and Distillation. A. M. Clark, London. From E. L. J. Boniface, Paris. Eng. Pat. 10,686, July 28, 1884.

The synanthrose and inulin contained in the tubers of the artichoke can only be partially converted into alcohol by distillation, various essential oils being also formed at the same time. The object of this invention is to prevent the formation of the essential oils, and to secure the maximum amount of alcohol. The tubers are pulped, and afterwards treated with a mineral acid and heated; the whole of the sugar-yielding substances being thus converted into levulose. The quantity of the acid is from 0·0005 to 0·005 of the weight of the juice, and the small excess of the acid does not necessitate the neutralisation of the juice before undergoing fermentation. A syrup may also be made by concentrating the juice in the same way as in the concentration of glucose syrups; the patentee points out that it differs essentially from glucose syrup, and consists only of levulose, and is not a mixture of dextrin and glucose. A beer may also be made in the manner usually pursued, but in this case a mineral acid must not be used.—C. C. H.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

Improvements in the Preservation of Meat Extracts. F. Walton, Twickenham. Eng. Pat. 16,376, December 12, 1884.

Mainly consist of processes of varnishing the external surfaces of the skins enclosing the essences or other meat preparations.—E. G. C.

Effects produced by the Sulphurous Acid of the Atmosphere of Towns. G. Witz. Bull. Soc. Ind. Rouen, **13**, 161.

Attention has been directed to the marked diminution of the quantity of atmospheric ozone during the recent epidemic of cholera in France. The observations taken at Paris and Marseilles, the results of which were com-

municated by M. Onimus to the Academy (December 15, 1884), clearly indicate a correlative bearing of the quantity of ozone upon the fluctuations of the epidemic. At Marseilles, during the month of July, the mean quantity was 0·86, as against 2·17 in the preceding year. In Paris, the mortality was at its height during the fortnight ending November 15, and the mean proportion of ozone during that period was 0·27, as compared with 2·00 for the corresponding period of 1883. Commenting upon these figures, in their purely chemical aspect, the author points out a factor of the results which has been hitherto ignored viz., the sulphurous anhydride proceeding from the combustion of coal and coal-gas, the quantity of which in large towns must be very considerable. The necessary destruction of ozone by this gas is the explanation advanced by the author of the definite variations of the proportion of ozone observed at Montsouris, with variations in the direction of the wind. The report furnished by this observatory for 1884 states that with the winds from south to west the proportion of ozone is large; but from south-west, through north to east-south-east, the quantity is small. Observations extending over seven years show a constant minimum coincidently with the prevalence of north winds. The position of Montsouris to the south of Paris suggested to the author the influence of the atmosphere of large towns upon the ozone of the air; and in considering this influence, *à priori*, the part played by sulphurous acid appeared to be probably the most important agency in the destruction of the active oxygen.

Some Constituents of Rain Water. Chairy. Bied. Centr. **14**, 209.

Rain water collected at the Meteorological Observatory of Algiers, was examined throughout the year, and the following substances determined:—Sodium chloride was present in quantities varying from 17·4 to 52·6 per million, iron as oxide or carbonate from 0·7 to 7·8 per million, whilst the quantity of ammonium nitrite varied from 0·14 to 0·29 per million, whereas of ammonium nitrate only traces were detected, and in two cases none at all. Neither iodine nor hydrogen peroxide were detected in a litre of water.—D. A. L.

A New Method or System of Treating Acid Waters to Purify them. B. Littlewood, Huddersfield. Eng. Pat. 8047, May 22, 1884.

A cistern is packed with a mixture of substances containing lime or its carbonate, potash or silica. Materials recommended are burnt clay, oyster shells, and a lime mortar carbonated by exposure to the air. The water is caused to rise through a mass of such material, and to flow over through a pipe at the top of the cistern.
—C. C. H.

An Improved Mixture for Disinfecting, Deodorising, and Antiseptic Purposes. G. R. Tweedie, London, and Hartins Crimson Salt Company, Limited, Worcester. Eng. Pat. 9538, June 28, 1884.

The improved mixture is formed of one or more of the manganates or permanganates of the alkali metals, one or more alums, chloride of sodium or potassium, borax or other combinations of the alkali metals with boric acid. Such a mixture is said to be more powerful for the purpose set forth than any of the components alone. The following proportions are given as yielding good results:—Potassium permanganate, 1 ounce; potash alum, 8 ounce; borax, 1 ounce; common salt, 6 ounce. The proportions may be varied with equally good results. The compound may be applied in the usual way in the form of powder or as a solution, in which case it is much more powerful.—C. C. H.

Improvements in the Treatment of Sewage or Foul Waters, or other Solid and Liquid Impurities or Foul Matters, for the purpose of Deodorising the same, and for the Prevention of the Formation of Sewer Gas. J. Hanson, Wakefield. Eng. Pat. 9587, June 30, 1884.

To effect the deodorisation of sewage and matters of a similar nature, the patentee proposes to add a solution of the waste product known as "black-ash waste." The drainings from waste heaps may also be used with an equally good effect. The "decoction" may be prepared by the addition of 28lb. of the waste to 100 gallons of water. The deodorisation is stated to be effected by "the vapours or vapourisable matters becoming fixed, and they cannot afterwards decompose."—C. C. H.

An Improved Compound for Disinfecting. H. B. Condy, Battersea. Eng. Pat. 10,015, July 10, 1884.

This invention deals with the production of permanganate of alumina for use as a disinfectant, this salt having the advantage of yielding, for the purpose of oxidation, five-sevenths of the oxygen it contains. In 1000 parts by weight of a solution of sulphate of alumina, containing one-third of its weight of the sulphate, 53 parts of permanganate of potash are dissolved by heat; the mixture is allowed to cool, and the potash alum formed crystallises out, leaving the permanganate of alumina and the excess of the sulphate of alumina in solution. The proportions given above may be varied, but those stated are the most convenient. In some cases where the solution is intended to be used quickly, it may be found advantageous to add the equivalent quantity of sulphuric acid instead of the sulphate—say, 1 part of acid for each 7 parts of the sulphate of alumina.
—C. C. H.

Improvements in Apparatus or Means to be employed in effecting the Softening or Purification of Water and for other Purposes. H. Porter and J. H. Porter, London. Eng. Pat. 10,459, July 22, 1884.

This invention has for its object an improved method of supplying automatically the solution of lime to the hard water undergoing treatment by the Clark process, and is an improvement upon former patents taken out by one of the present patentees. The lime water is admitted into a vessel containing an indiarubber or flexible bag, which bag is afterwards distended by water, admitted under pressure, and thus forces out the reagent into the vessel in which the admixture with the hard water is effected.—C. C. H.

An Improved Process of Deodorising, Disinfecting, Precipitating, Drying, and Pulverising the Solid Portions of Sewage to render it a Marketable Manure. W. Astrop, Tottenham. Eng. Pat. 11,901, Sept. 2, 1884.

The precipitation of the sewage is effected in tanks in the usual way with a combination of sulphate of calcium, carbonate of alumina, sulphate of potash or soda, and finely-ground ashes. The reagent is obtained by mixing milk of carbonate of lime with sulphate of alumina, or soda of potash alum; "carbonate of alumina" is formed, the calcium carbonate is transformed into hydrated sulphate of calcium, and the potash or soda salts remain as their respective sulphates. After the precipitation is effected, the sludge is collected from the tanks and discharged on to a travelling band which passes over vacuum boxes, the water thereby being removed to a considerable extent. The partially-dried sludge is then passed through rollers, where a further quantity of moisture is removed. The cake passes on the same band, and is discharged into a revolving drum formed of open wire-work, through which a current of hot air is drawn by a fan or other means, the dried sludge finally being discharged through the meshes of the drying cylinder ready to be bagged as a manure.—C. C. H.

Improvements in Filtering Compounds and in the Construction of Filters for Industrial and other Purposes. C. E. Chamberland, Paris. Eng. Pat. 3423, March 17, 1885.

The filtration of water, especially that used for domestic purposes, is effected through a medium composed of pipe clay and porcelain clay, the proportions of which may vary. The mixture is moulded into the desired shapes, and baked at a temperature of 2400° F. The apparatus consists of a number of tubes made as above described,

and placed in the interior of a cylindrical vessel into which the water is forced; it filters through the tubes into the lower part of the apparatus effectually purified. Three claims are made for the compound as described and the apparatus.—C. C. H.

Destroying and Utilising Sewage in Buildings, Towns, and Cities. A. Engle, Metz, Iowa, U.S.A. Eng. Pat. 4046, March 31, 1885.

To effect the objects described in the title, the patentee proposes to collect the excreta, both solid and liquid, in a vessel in connection with the pan of the closet, etc., from whence it falls, on the opening of a suitable valve, into a retort. When the retort is charged the whole is submitted to destructive distillation; the gaseous bodies are collected into a pipe and passed through the furnace surrounding the retort, so that they are not only effectually destroyed, but also afford heat for the distillation of the contents of the retort itself.—C. C. H.

Improvements in Processes for Treating Sewage and other Waste Waters for obtaining the Fats, Fatty Acids, and Fibrous Matter contained in the same, and in Apparatus to be employed therewith. W. H. Beck, London. From H. Wagener and Professor Dr. A. Müller, Berlin. Eng. Pat. 4207, April 2, 1885.

The object of this invention is the extraction and utilisation of fat, grease, cellulose and fibrous matter from sewage. The sewage is first settled in a tank in order to deposit the sand and heavy ponderable matter, after which it is passed through an apparatus described in the specification at great length. The operation is as follows:—The sewage water is led through a succession of pipes to a receptacle where the remainder of the fine sand is settled out and carried away by a screw in the lower part of the U-shaped tank. From this tank the liquid passes into a conical screen, where the coarser fibrous matter is intercepted, and delivered on to a travelling band, which carries it from the machine, to be treated as described further on. The finer fibrous matter is then taken out by a travelling wire-work screen, provided with brushes, and delivered into a tank at the end of the machine. The liquid sewage passing from the machine is treated with lime or any other process, and the fine mud collected, and after treatment by an acid to liberate the fat from the lime soap formed, is shaped into cakes in a filter press, and treated with any suitable solvent to extract the grease. The fibrous matters are finally treated in a similar manner to obtain the fatty matters, and the residue made into paper or coarse cardboard.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Decomposing Metallic Haloid Salts by Electrolysis. C. Hoepfner, Berlin. Eng. Pat. 6736, April 23, 1884.

In the electrolysis of haloid salts of the light and heavy metals, especially those of the alkalis, the difficulties resulting from polarisation have hitherto hindered an advantageous application of electricity on the large scale. The present process consists chiefly in preventing polarisation by the use of depolarising substances at the cathode, or by circulation of the electrolyte. It is thus possible to decompose chlorides, and to utilise the chlorine therein. Thus, to prepare by electrolysis from any chloride, the chlorine required for the extraction of metals, a conducting substance which cannot be attacked by chlorine, such as carbon or manganese ore, is used as an anode in the solution of the chloride, this solution being caused to continually flow in and out at the same, whereby the chlorine liberated is carried away. According to the speed of flow of the liquid, so can it be more or less saturated with chlorine. To avoid the separation of hydrogen at the cathode, the latter, which may consist of any conducting material, is surrounded with a substance which prevents polarisation; such substances are those which are reducible by hydrogen. The salt lyes, charged with chlorine, by this method may be employed for the extraction of silver and gold. The chloride lye is first saturated with chlorine at the anode, then mixed with auriferous ore and reduced at the cathode, and then returned to the anode for a fresh charge of chlorine. Other applications of the process are indicated.—J. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in Sulphite Wood Pulp. S. Pitt, Surrey. England. From R. P. Pictet and G. L. Brélaz, Switzerland. Eng. Pat. 9509, June 27, 1884.

The chief points of interest in this specification are:—(1) The use of supersaturated aqueous solutions of sulphurous acid gas, having a gaseous tension of from 5 to 6 atmospheres at a temperature below 100° C. (2) The use of a vacuum for mechanically removing the air contained in the wood, to facilitate the penetration of the acid liquid into the fibres, (3) Employing temperatures below 100° C., in order to avoid the decomposition of the resinous, etc., incrusting matters in the wood. (4) "Reutilising the solutions from the boilers, and recovering a large portion of sulphurous acid gas contained in these liquids." (5) Preparation of "gums, resins, tannin, alcohol etc.," from the solutions of incrusting matter. Attention is drawn to the fact that the high temperature which it is essential to employ with sulphites of soda, etc., cause the formation of particles of tar or pitch which penetrate the fibre, and render bleaching laborious and very costly. The washings, etc., which then become essential, much injure the whiteness of the product; the yield is reduced, and the strength of the fibre impaired by the repeated action of bleaching liquor. When the wood is sufficiently boiled, the acid solution contains a number of different products, of which the following are the principal: (1) A large proportion of gums, resins, and glucose from the incrusting substances and essential oils of wood. (2) Sulphate of lime in small proportion. (3) Almost the whole of the sulphurous acid. "The bleaching by chloride of lime is preceded in this manufacture by the action of sulphurous acid, which diminishes very considerably the cost of this operation."—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Method for the Preparation of Quinoline Disulphonic Acids. N. La Coste, Aachen. Ger. Pat. 29,920, April 20, 1884.

The mixture of the two isomeric monosulphonic acids obtained by the treatment of quinoline with fuming sulphuric acid, is heated with the double quantity of fuming sulphuric acid to 200-240°. From the product the sulphuric acid is separated in the usual manner, the disulphonic acids are converted into the potassium salts, and separated by repeated crystallisation; potassium α-quinoline disulphonate being the more soluble one. By melting the potassium or sodium salts of the quinoline disulphonic acids with about 3 parts caustic potash or soda at 180-200°, the salts of the corresponding oxyquinoline sulphonic acids, $C_9H_5N.SO_3H.OH$, are formed. By increasing the quantity of caustic alkali to 5 parts for 1 of quinoline disulphonate, and raising the heat to 290-310°, dioxyquinolines, $C_9H_5N(OH)_2$, are formed. In order to separate the α-dioxyquinoline, which is the principal product of the reaction, the melt is carefully neutralised with hydrochloric or sulphuric acids, and the α-dioxyquinoline extracted by means of ether. By evaporating the neutral or slightly-acid solution of the melt to dryness, the dioxyquinoline or its salts can also be extracted from it by alcohol, wood-spirit or similar solvents.
—F. M.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Method for the Estimation of Free Sulphuric Acid in Vinegar. B. Kohnstein. Dingl. Polyt. J. **256**, 128.

100cc. of vinegar are neutralised with the necessary quantity of pure magnesia, and filtered. From 25cc. to

30cc. of the filtrate are evaporated to dryness in a platinum basin. The residue is gently ignited until all the magnesium acetate is decomposed. Water containing carbonic acid is then added, and the whole again evaporated to dryness, in order to render the magnesium carbonate formed during the process of ignition more granular, as in this state it is easier to wash. The magnesium sulphate is extracted from the carbonate by means of hot water. After separating the small quantity of lime which may happen to be present in the filtrate, the magnesia contained in it is estimated as pyrophosphate. From the quantity of the latter the quantity of free sulphuric acid contained in the vinegar may be calculated. The author gives the results of some analyses of mixtures of pure dilute acetic and sulphuric acids of known composition, which testify to the value of his method. The small quantities of magnesium salts usually occurring in vinegar may influence the results, but the error is so slight that it may safely be neglected.
—F. M.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

8190 J. C. Mewburn, London—Communicated by F. C. E. Simon, France. Improvements in evaporating, distilling, and refrigerating apparatus. July 6

8225 H. C. Paterson, Glasgow. Improvements in smoke-consuming furnaces. July 7

8301 T. C. Fawcett, Halifax. Improvements in machinery for making saggers, crucibles, and similar moulds, also applicable to the moulds of brick-making machines. July 9

8353 A. E. Robinson, Edgbaston. Improvements in appliances for producing and condensing vapours. July 10

8527 W. R. Lake, London—Communicated by J. W. Hyatt, United States. Improvements in filtering apparatus. July 14

8615 R. Kullig, London. Improvements in Royle's condensation apparatus. Complete specification. July 16

8630 E. Edwards. London—Communicated by L. Rohrmann and M. Hiller, Germany. Improvements in apparatus for effecting the absorption of gases or vapours by liquids. July 16

II.—FUEL, GAS, AND LIGHT.

7581 E. Capitaine and O. Brunler, London. Improvements in the production of compressed gaseous compound for use in gas motors and for other purposes, and apparatus therefor. Complete specification. June 22

7615 J. D. Bodwell, London. Improvement in apparatus for the combustion of liquid fuel. Complete specification. June 23

7613 L. A. Groth, London—Communicated by F. Garavagnoe & Co., Italy. A new or improved gas carburetting apparatus. June 23

7791 S. Butler, London. Improvements in apparatus for mixing and heating materials for the manufacture of patent fuel. June 26

7815 R. Dempster, Manchester. Improvements in the construction of stand pipes for gas retorts. June 27

7893 T. G. Marsh, Failsworth, Lancashire. Improvements in gas-lighting and heating. June 30

8005 W. A. McIntosh Valon, London. Improvements in machinery or apparatus for the manufacture of compressed artificial fuel. July 1

8097 H. J. W. Raphael and J. Syme, London. Improvements in means for preventing nuisance from smoke, and for utilising the gaseous products of combustion from furnaces or the like for lighting or other purposes. July 3

8516 T. Chappell and C. H. Adames, Blackstock Road. Improvements in the manufacture of fuel. July 14

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

7563 A. M. Clark, London—Communicated by A. Cozé, France. Improvements in retorts for the distillation of coal and other solid matters, and in apparatus connected therewith. June 20

8181 L. T. Wright, London. Improvements in or connected with the hydraulic mains used in the distillation of coal. Complete specification. July 6.

IV.—COLOURING MATTERS AND DYES.

7491 H. J. Haddan, London—Communicated by Dr. R. Worms, Saxony. A new manufacture of blue colouring matter. June 19

7630 C. E. Avery. London. The improved manufacture of extracts and liquors of logwood. Complete specification. June 23

7731 L. Heffter, London. Drying alizarin and dissolving it afterwards. June 25

7844 H. H. Lake, London—Communicated by Wirth & Co., agents for A. Liebmann, Germany. Improvements in the manufacture of naphthylamine sulpho-acid. June 27

8211 T. Frusher, London. Improved manufacture of ink from waste dye liquors. July 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

8413 A. Whowell, London. Improvements in apparatus employed for bleaching purposes. July 13

VII.—ACIDS, ALKALIS, AND SALTS.

7514 G. H. Bolton, Liverpool. Improved fastening device applicable to, or improvements in, heads and lids or covers of caustic soda or other drums, etc., in which a nearly cylindrical part is required to be quickly fastened and loosed. June 20

7657 E. W. Parnell and J. Simpson, Liverpool. Improvements in the separation of sulphuretted hydrogen from nitrogen. June 24

7691 R. T. Freeman, London. An improvement in nitrous oxide gas or other compressible gases or gas bottles. June 24

7831 T. Capper, London—Communicated by Dr. S. Pick, Austria. Improvements in apparatus for making bicarbonate of sodium. June 27

7811 O. N. Witt, London. A process for the manufacture of hydrochloric acid adapted to be used in connection with the ammonia soda process. June 27

7867 A. Brin, London. Improvements in the manufacture of bioxide of barium and its use in making oxygenated water for bleaching or for other purposes. June 29

8071 C. C. Springer, Manchester. Improvements in the manufacture of sulphurous acid gas (SO_2), and in the apparatus employed in such manufacture. July 3

8191 B. J. B. Mills, London—Communicated by J. M. Duncan, United States. Improvements in means or apparatus employed in the manufacture of salt from brine, and in producing strong brine for the manufacture of soda ash, and other chemicals. July 6

8260 T. Robinson, Glasgow. Improvements in the manufacture of alum and sulphate of alumina. July 8

8304 T. B. Saunders and A. V. Saunders, Bradford. Improvements in the method of, and apparatus for, generating dry hydrochloric acid gas for the carbonisation of vegetable matter mixed with wool and woollen rags. July 9

8382 H. Richardson, Jarrow-on-Tyne. Improvements in the manufacture of hydrate, sulphate, and other salts of alumina. July 11

8392 W. P. Thompson, Liverpool—Communicated by B. Osann, Germany. A new or improved process of manufacturing caustic alkalis during the purification of iron by the Thomas-Gilchrist process. Complete specification. July 11

8440 E. W. Parnell and J. Simpson, Liverpool. Improvements in obtaining sulphuretted hydrogen from sulphide of ammonium. July 13

8470 F. Maxwell-Lyte, London. Improvements in the production of chlorine and apparatus therefor. July 13

8499 W. Allen, London. Improvements in acid taps and valves and seats for chemical works. July 14

8511 H. Leplay, London. Improvements in decarbonating the carbonates of strontia and baryta, and in apparatus therefor. Complete specification. July 14

8602 N. Glendinning, Liverpool. Improvements in the treatment of copper liquors. July 16

8623 S. H. Johnson and C. C. Hutchinson, London. Improvements in preparing milk of lime, and in apparatus to be used therefor, and for other such like purposes. July 16

VIII.—GLASS, POTTERY, AND EARTHENWARE.

7937 C. C. Thompson, London. Improvements in machines for making pottery, glass-ware, and articles of all kinds from soft plastic materials which are capable of being moulded. Complete specification. June 30

8554 W. P. Thompson. London—Communicated by C. Potts and A. Potts, United States. Improvements in machinery applicable for finely dividing and tempering clay. Complete specification. July 15

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

7912 W. B. Smith. London. Improvements in binding bricks and other building blocks. June 30

8153 W. P. Thompson, Liverpool—Communicated by R. Bosse and F. Wolters, Germany. Improved process for rendering cements hydraulic, that is to say, capable of setting and hardening under water. July 6

8347 T. C. Fawcett, Halifax. Improvements connected with machinery for making bricks, tiles, pipes, and tubes. July 10

8361 J. Matthew, London. Improvements in the treatment of stone in order to produce a glazed surface thereto. July 10

8508 R. Stanley, London. Improvements in machinery for pressing and moulding bricks, tiles, and the like. July 11

X.—METALLURGY, MINING, Etc.

7510 P. Jensen, London—Communicated by J. Omholt and The Chemische Fabrik Gossnitz, Germany. Improvements in the continuous manufacture of light metals by application of electrolysis and in apparatus therefor. June 19

7571 G. A. Jarvis and A. E. Tucker, Shifnal. Improvements in Bessemer or basic converter bottoms, plugs, or blocks. June 22

7597 J. Y. Johnson, London—Communicated by E. Deligny, France. An improved process for purifying copper precipitates. June 22

7710 J. M. H. Munro, London. Improvements in the treatment of basic cinder. June 25

7762 E. Robbins, London. Improvements in plain, ornamental, decorative, and constructive works manufactured from slag. June 25

7802 E. Fletcher, London. Improvements in the treatment of pig iron for eliminating impurities during the process of its conversion into malleable iron or steel, also applicable for analogous purposes. June 26

7805 J. Platt, Sheffield. Improvements in furnaces for metallurgical and other purposes. June 26

7846 T. Hampton, Manchester. Improvements in the manufacture of steel ingots. June 29

7858 H. von Grousilliers, London. A process for producing aluminium (Al) from chloride of aluminium (Al_2Cl_6) by employing pressure. Complete specification. June 29

7866 J. Y. Johnson, London—Communicated by J. Jacobi, Austria. Method of obtaining phosphatic slags of high titre by the Thomas-Gilchrist process. June 29

7880 J. P. Reitz, Bockenheim, Germany. Acid-proof gunmetal. June 29

8008 P. C. Bunn, London. The utilisation of the by-products or waste of lead ores for the manufacture of pigments therefrom. July 1

8039 H. Bain, London. Tinning and finishing tin and terne plates and in machinery used therefor. July 2

8161 W. E. Gedge, London—Communicated by G. Guillemin, France. A novel alloy intended to replace copper in its principal applications. July 6

8269 T. Nordenfelt, London—Communicated by C. G. Wittenström, Sweden. Improvements in the manufacture of castings from wrought iron and steel. Complete specifications. July 8

8295 P. J. Davies, London. Improvements in apparatus for lead burning. July 8

8318 T. Bayley, Birmingham. Improvements in the treatment and utilisation of scrap tin plates. July 9

8336 C. D. Abel, London—Communicated by F. C. Glaser, Germany. Manufacture of blocks of combined ingot iron and puddled or faggot iron. July 9

8360 E. Watkins, Eagleville, California. Improved welding compound and process of preparing the same. July 10

8418 J. Y. Johnson, London—Communicated by E. Deligny, France. An improved process for purifying copper precipitates. July 11

8478 J. T. King, Liverpool—Communicated by S. T. Owens, United States. Improvements in metallurgical furnaces. Complete specification. July 11

8481 A. H. Emery, London. Improvements in wrought metal plates for use in the construction of boilers, ships, and other bolted or rivetted work, and in the manufacture and treatment of the same. July 14

8487 A. H. Emery, London. Improvements in wrought metal columns, beams, girders, and other members designed to bear compression or transverse loads in bridges, buildings, and other structures, and in the manufacture and treatment of the same to increase their rigidity and strength. July 14

8574 H. R. Cassel, London. An improved process and apparatus for treating metals, alloys, and especially auriferous ores, by electrolysis. July 15

XI.—FATS, OILS, and SOAP MANUFACTURE.

7645 T. Berliner, London. Process and apparatus for extracting fat from bones and other fatty matter. June 23

7701 J. Y. Johnson, London—Communicated by C. Goublier, France. Improvements in the manufacture of candles. June 24

7972 O. C. Hagemann, London. Improvements in the purification of glycerine. July 1

7973 O. C. Hagemann, London. Improvements in purifying and concentrating glycerine, applicable also to the concentration of other matters. July 1

8051 O. C. Hagemann, London. Improvements in the treatment of soap leys to obtain products therefrom. July 2

8250 F. Walton, London. Improvements in the manufacture of oxidised or solidified oil, and in the application of the same to wires and strands. July 7

8403 A. Michel, London. Improvements in apparatus for treating fatty matters in order to obtain fatty acids and glycerine therefrom. July 11

XII.—PAINTS, VARNISHES, and RESINS.

7485 A. McLean, London. Improvements in the manufacture of pigments. June 19

7498 H. H. Lake, London—Communicated by S. Roebuck, United States. An improved composition or paint for coating brickwork, ironwork, and the bottoms of ships, and for similar purposes. Complete specification. June 19

8008 P. C. Bunn, London. The utilisation of the by-products or waste of lead ores for the manufacture of pigments therefrom. July 1

8050 T. Terrell, London. Improvements in the preparation of pigments from sulphate of iron. July 2

XIII.—TANNING, LEATHER, GLUE, and SIZE.

7561 W. Paul, London. Improvements in machinery for boarding, softening, and graining leather. Complete specification. June 20

7818 A. Johnson, Liverpool. Improvements in leather, and in the manufacture or treating of the same. June 27

7915 T. R. Clark, London. Improved process for the manufacture of glazed leather. Complete specification. June 30

8626 G. F. Redfern, London—Communicated by A. Buckingham, Belgium. The manufacture of an improved material to be used as a substitute for leather, and for other purposes. July 16

XV.—SUGAR, STARCH, GUM, Etc.

7533 A. Ralu (fils), J. Grathvohl and H. A. Brown, London. Solidifying syrups and molasses, especially those of sorgho and sugar cane, by mixing them with substances adapted for distillation. June 20

7590 E. Hoefling, London. Improvements in the manufacture of gelatine. June 22

7617 J. H. Brinjes, London. Improvements in or connected with vacuum apparatus employed in the manufacture or refining of sugar, or for other purposes. June 23

7745 C. W. Guy, London. Improvements in sugar-cane crushing mills. June 25

7914 F. Wilhöft, London. Improvements in vulcanised soft rubber, and process of making the same. Complete specification. June 30

8000 A. Seyberlich and A. Trampedach, London. Improvements in the manufacture of crystallised grape sugar. July 1

8279 H. H. Lake, London—Communicated by F. O. Matthiessen, United States. Improvements relating to the filtration and decolourisation of sugar liquor, or syrup, and to apparatus therefor. July 8

XVI.—BREWING, WINES, SPIRITS, Etc.

7531 A. Ralu (fils), J. Grathvohl and H. A. Brown, London. Utilising as a commercial and industrial substance, sweet potatoes and yams (Ypomæa, Batatos, and Dioscorea), by means of desiccation and pulverisation. June 20

7535 A. Ralu (fils), J. Grathvohl and H. A. Browne, London. Distilling spirits from desiccated or triturated sweet potatoes and yams. June 20

7736 T. J. Canty, London. An improved self-acting apparatus for heating and circulating worts in brewers' mash tuns. June 25

7744 E. Luck, London. Improvements in or additions to apparatus for the manufacture of perfumed or flavoured spirit. June 25

7788 L. Cuisinier, Liverpool. A new and useful process for preventing from any possible alterations the saccharification of amylaceous substances by malt. June 26

7826 T. P. Hinde, Darlington. Boiling malt liquors, etc., by the application of gas. June 27

7835 A. A. Vale, London—Communicated by The Chemische Fabriks Actien Gesellschaft, Germany. A method of rendering spirits unfit for use as liquors for drinking. June 27

8142 G. Smallman, Newnham. The better ventilating and heating of hop and malt kilns. July 6

8563 S. Rhoden, London. Improvements in brewers' and distillers' mash tuns. July 15

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

7703 B. D. Healey, Liverpool. Improvements in furnaces for burning town refuse and decomposing the fumes therefrom. June 25

7714 P. Smith, Fallowfield, Manchester. Improvements in the means and apparatus for the separation of solids and semi-solids from sewage and other liquids. June 25

7759 J. M. H. Munro, S. H. Johnson, and C. C. Hutchinson, London. Improvements in the treatment of sewage. June 25

7958 W. H. Hartland, Glasgow. Improved means for filtering and purifying water. June 30

8058 W. B. G. Bennett, London. Improvements in the method of and arrangements for treating and disposing of sewage, and purifying foul water. July 2

8084 S. Hubbard James, Tottenham. Improvements in the treatment of sewage. July 3

8162 W. Hucks, London. Improvement in the separation or filtration of solid and liquid matter. July 6

8282 O. F. Öberg, London. A new mode of manufacturing filtering material for purifying water from micro-organisms. Complete specification. July 8

8406 W. D. Borland, Stowmarket. Improvements in disinfectants. July 11

XIX.—PAPER, PASTEBOARD, Etc.

7195 H. J. Haddan, London—Communicated by C. H. Voigt, Saxony. Process for preparing fodder from certain waste products obtained in the manufacture of cellulose or paper pulp. June 19

7772 J. Petrie and F. W. Petrie, Rochdale. Improvements in machinery for cleansing "Esparto" and other grass and fibrous material used in the manufacture of paper. June 26

7886 J. G. Stephens. London. Improved method of and apparatus or machinery for cleaning and separating the pulpy matters from the fibres of leaves and plants. June 29

7932 C. H. Roeckner and F. L. Roeckner, London. Improvements in pulp strainers. June 30

8012 A. J. Boult, London—Communicated by W. C. Zeidler, Canada. Improvements in the treatment of celluloid, xylonite, and of similar substances. Complete specification. July 1

8073 C. C. Springer, Manchester. Improvements in the construction of boilers for treating wood and other fibre in the manufacture of paper and other pulp. July 3

8130 T. R. Shillito, London—Communicated by C. Arnold, Germany. Improvements in the manufacture of paper parchment or vegetable parchment. Complete specification. July 4

8244 G. M. Peters, London. Improvements in machines for manufacturing cartridge shells from paper, wood pulp, etc. Complete specification. July 7

8396 H. Mason, London. A machine for the manufacture of parchment paper. July 11

8434 J. Wood and R. Penman, Edinburgh. An improved pulp strainer for straining pulp before it passes to the paper-making machine. July 13

8616 F. X. Black, London. Improvements in pulp-screening machinery. Complete specification. July 16

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

7527 H. N. Draper, Rathmines. The preparation of a colourless or decolourised solution of iodine. June 20

8523 H. E. Newton, London—Communicated by G. Michaelis and W. T. Mayer, United States. Improvements in the manufacture of chloroform and acetic acid or purified acetates. Complete specification. July 14

8597 E. Kent, London. Iodine colloid for external medicinal use. July 16

XXI.—EXPLOSIVES, MATCHES, Etc.

7610 A. J. Boult, London—Communicated by W. F. Wolff and M. de Forster, Germany. An improved method of charging hollow projectiles with compressed granular explosive substances. Complete specification. June 23

7725 T. Smith, London. Safety dynamite shells, or shells loaded with other dangerous explosives. June 25

XXII.—ANALYTICAL CHEMISTRY.

8610 C. G. P. de Laval, London. A new method of and apparatus for determining the quantity of fat in milk. July 16

*ENGLISH PATENTS PUBLISHED.**

APPLIED FOR DURING 1884 AND 1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

1884.

10812 J. Mactear. Furnaces for chemical processes. 6d

1885.

5903 O. Imray—Communicated by H. B. Scott. An improvement in filter presses. 4d

6053 E. Burton. Furnaces for the combustion or destruction of refuse. 6d

*Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows :—

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II.—FUEL, GAS, AND LIGHT.

1884.

11040 A. F. Link—Communicated by T. Bauer. Improvements in the construction of coke ovens. 6d

11543 T. Nordenfelt—Communicated by L. Nobel, C. G. Wittenstrom, E. Faustman and P. Ostberg. Apparatus to be employed in burning naphtha or other volatile liquid, applicable especially for melting metals which are difficult of fusion. 8d

1885.

802 A. J. Boult—Communicated by J. Hanlon. The manufacture of illuminating gas from hydrocarbon or other oils, and apparatus therefor. 8d

5113 F. Leslie and J. A. Wanklyn. Improvements in the treatment of gas, and in the materials and apparatus employed therein. 2d

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

1884.

10790 J. Dempster. Apparatus for extracting tar and ammonia from the gases of blast furnaces. 6d

11202 J. Coates. Process and apparatus for extracting benzol from the gases evolved in sealed or closed coke ovens. 4d

REPRINT.

12291 (1848). R. A. Smith. Coal tar. 4d

IV.—COLOURING MATTERS AND DYES.

1884.

11159 J. H. Johnson—Communicated by H. Caro. Manufacture of colouring matters from tetramethyldiamidobenzophenone and analogous ketone bases. 4d

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

1884.

10191 A. Wilkinson. Treating wood and vegetable fibres fo the manufacture of textile fabrics. 4d

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

1884.

11333 G. Lunge. The application of chloride of lime for bleaching and other purposes. 4d

11456. F. A. Gatty. Dyeing certain colours on cotton yarns and fabrics. 4d.

11824 W. R. Lake—Communicated by — Corron. Dyeing textile or fibrous materials. 6d.

1885.

2008 A. Whowell. Improved agitator and boiler for bleaching and finishing purposes. 4d

VII.—ACIDS, ALKALIS, AND SALTS.

1884.

9317 W. Spence—Communicated by J. J. Thyss. Apparatus for the production of sulphuric acid. 6d

9761 A. C. Henderson—Communicated by L. Labois. Method and apparatus for extracting sulphur from pyrites. 6d

10080 W. Robinson. Method of making sodium carbonate and certain bye-products. 2d

10138 C. M. Pielsticker. The manufacture of hydrate of strontia from sulphate of strontia. 4d

10654 J. Mactear. Making granulated crystalline carbonate of soda, and apparatus therefor. 6d

10813 J. Mactear. Process for obtaining or recovering manganese oxide from manganese sulphate produced in obtaining chlorine. 2d.

10860 H. E. Newton—Communicated by A. Nobel and G. Fehrenbach. Manufacture of anhydrous sulphuric acid. 6d

10871 C. D. Abel—Communicated by La Societé de Javel. Method and apparatus for recovering the nitrous products in the manufacture of sulphuric acid. 6d

11161 T. Macfarlane. The manufacture of sulphide of sodium and sulphide of zinc. 4d

12159 J. Clare. Packages for containing caustic soda and other articles, and lids or covers for the same. 4d

13045 J. H. Johnson—Communicated by T. Macfarlane. The manufacture of sulphide of zinc, and the obtainment of sulphuretted hydrogen and sulphurous acid as products of the said manufacture. 4d.

5216 W. P. Thompson—Communicated by L. Imperatori. Process for the production of phosphate of soda or of potash from basic process slags, etc. 2d

REPRINTS.

13775 (1851) C. Watt. Decomposing saline substances. 8d

422 (1854) W. Gossage. Manufacture of alkaline carbonates. 10d

VIII.—GLASS, POTTERY, AND EARTHENWARE.

1884

13119 F. Mason and J. Conquerer. Manufacture of rolled plate glass. 6d

1885.

1633 G. W. Wilkinson. Gas kilns for burning glass, china, pottery ware, etc. 6d

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

1884.

11292 A. M. Clark—Communicated by G. von Koch and R. Adamy. Treating cement in order to make it suitable for stereochromatic printing. 2d

1885.

3932 J. Homan. Improvements in fireproof floors. 6d
4151 W. E. Hoys—Communicated by E. Ladewig. Manufacture of fire and waterproof boards or paper from asbestos. 4d
5538 P. Walker. Making lithographic stones, baths, sinks, etc., of Portland cement. 2d
5579 A. Diss and H. Goodey. Manufacture of fireproof hearths and other fireproof parts of buildings. 4d

REPRINTS.

160 (1857) F. Walton. Plastic compositions. 6d
1211 (1857) F. Walton. Plastic compositions. 4d

X.—METALLURGY, MINING, ETC.

1884.

10886 J. Taylor and J. Taylor. Preparing iron and steel sheets, etc., for coating them with copper and alloys of copper. 4d
11196 H. E. Newton—Communicated by J. E. Verdié. Manufacture of steel and cast iron. 4d
11701 H. M. Whitehead. Means of extracting gold or silver from their ores, and apparatus connected therewith. 6d
15880 F. Radcliffe. Improvements in open hearth gas furnaces for the manufacture of steel. 6d

1885.

5642 L. A. Groth—Communicated by C. G. Dahlerus. Method of extracting copper, nickel, cobalt, silver, or gold from their ores. 2d
5646 C. Scheibler. Manufacture of steel and iron, and obtaining by-products of such manufacture. 4d

REPRINT.

12373 (1848) W. Clay. Rolling iron, etc. 6d

XI.—FATS, OILS, AND SOAP MANUFACTURE.

1884.

11305 S. M. Dimbleby. The manufacture of soap and saponaceous compounds. 2d
11403 H. H. Lake—Communicated by G. G. B. Casero. Process for the extraction of oil and the production of meal from flax and other seeds. 4d
11639 J. Hopkinson. Improvements in lubricants. 2d

XII.—PAINTS, VARNISHES, AND RESINS.

1884.

11660 H. H. Lake—Communicated by L. Brown. Coating or covering wood or other surfaces, and paint or composition therefor. 4d
11930 J. Conner. An improved black pigment. 2d
12280 A. Parkes. The production of compounds capable of being employed for the coating or covering of metallic, animal, vegetable, or other surfaces. 4d
11776 A. Parkes. The production of compounds capable of being employed for coating metallic and other surfaces. 4d

XIII.—TANNING, LEATHER. GLUE, AND SIZE.

1884.

11288 A. M. Clark—Communicated by E. do Solminlhac. Improved apparatus for use in tanning hides and skins. 6d
11586 W. A. Barlow—Communicated by La Société de Fabrication Perfectionée d'Extraits Tanniquc. Process and apparatus for the manufacture of extracts of tannin. 6d

1885.

5359 W. R. Lake—Communicated by J. B. Duprot. Impermeable and preservative compositions for use in the preparation of leather, etc. 4d

REPRINT.

745 (1855) L. Cornides. Waterproofing leather. 8d

XVI.—BREWING, WINES, SPIRITS, ETC.

1884.

10870 C. D. Abel—Communicated by J. A. F. Bang and M. C. A. Ruffin. Process and apparatus for purification of alcohol. 6d
11297 T. Etty. Non-intoxicating beer, and process for manufacturing the same. 4d
11407 H. H. Lake—Communicated by A. F. le Myé and W. de Peyster. Apparatus for treating ligneous substances for the production of glucose and alcohol. 6d
12105 J. C. Mewburn—Communicated by La Société "La Vinicole." The manufacture of champagne or sparkling wines. 2d

1885.

5139 C. D. Abel—Communicated by C. Meyer. Preventing subsidiary fermentations in substances employed in the various manufactures based on fermentation. 4d

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

1884.

8745 P. A. Maignen, London. Method of softening water. 6d
10973 J. Carter. Filtering and purifying water, sewage and other liquids; separating the liquids from the solids, treating the solids for manure, and other methods of purifying rivers. 8d
11641 E. J. Leveson and J. W. Slater. The preparation of agents to be used in the treatment of sewage, etc., and the treatment of such matters. 4d
15701 W. Noble. Means of consuming smoke in steam boiler furnaces. 6d

1885.

3554 C. Jeffs. Preserving fish in a fresh condition. 2d
4677 T. Stoner and J. Turton. A combined disinfecting and fumigating compound. 2d
5664 A. Ramognino. A new or improved composition of chocolate. 2d

XIX.—PAPER, PASTEBOARD, ETC.

1884.

10240 A. Wilkinson. Treating vegetable material for the manufacture of pulp suitable for paper, millboards, etc. 4d
10400 S. Law. Method and apparatus for neutralising the acid in extract fibre. 6d
11816 A. Mitscherlich. The manufacture of paper pulp. 8d

1885.

5610 H. H. Leigh—Communicated by C. Eichorn and T. Mohr. The softening of vegetable parchment. 2d

XXI.—EXPLOSIVES, MATCHES, ETC.

1884.

10986 T. Wilkens—Communicated by T. Petry and O. Fallenstein. An improved explosive compound. 4d
11808 R. W. S. Griffith. Improvements in the manufacture of gunpowder. 4d

1885.

2139 A. Favièr. New explosive compounds. 6d
4853 J. Paulus. Caps or apparatus for exploding dynamite. 6d

REPRINTS.

2675 (1861) A. Parkes. Compounds of gun-cotton, etc. 4d
3127 (1867) E. C. Prentice. Treating gun-cotton and cartridges. 4d
1830 (1873) S. J. Mackie and C. A. Faure. Explosive compounds. 4d

XXII.—ANALYTICAL CHEMISTRY.

1885.

5991 A. M. Clark—Communicated by E. F. von Marxow. Method and apparatus for the quantitative estimation of hæmoglobin in the blood. 6d

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INTERNATIONAL INVENTIONS EXHIBITION, LONDON.

REPORT ON THE EXHIBITS RELATING TO THE CHEMICAL INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, Manchester, etc.

[In this Report the exhibits of the various industrial branches will be described as nearly as possible in the order observed in the general arrangement of the matter printed in this Journal.]

FUEL, GAS, LIGHT, Etc.

The Simon-Carvés Coke-ovens, with Accessory Plant (*Group II. No.* 210).

An inspection of the fine model of the Simon-Carvés coke-oven, together with the specimens exhibited, will practically answer any questions that may be asked concerning these ovens. The colouring matters and dyed specimens shown are sufficient to prove to the most sceptical that the tar contains the aromatic

substances always found in ordinary gas-tar, and that it is identical with the latter in composition. The specimens of ammoniacal liquor and ammonium sulphate indicate the value of the aqueous by-product. The Carvés oven is not one which has been suddenly developed in its present form. Mons. Carvés was certainly the first, many years ago, when he improved the old Knab's coke-oven, to recognise the fact that an aromatic tar must be a high-temperature tar, that it must be generated in a closed coking-space, and that the high temperatures required must be evenly applied throughout the mass of fuel. He solved the problem both as regards the coke for blast-furnaces and other metallurgical purposes for French and Belgian coals, and Mr. Henry Simon of Manchester, in conjunction with M. Carvés, is solving it very satisfactorily in the case of many of the English coals. However, the solution of the coke problem is, after all, by no means a one-sided matter, for it is the great ironmasters of this country that must decide the question as to whether it will stand as well and go as far as the cokes produced in other forms of coke-oven. The tar and ammonia questions have no charms for them, except in cases in which they have coke-ovens of their own, and hence the test of their experience may be looked upon as a crucial one. Quite recent work in these ovens with Staffordshire coal is yielding coke so exactly identical, even in appearance, with that from the Beehive ovens, that it is being bought by ironmasters for blast-furnace use as fast as it can be made, and at the usual prices.

In the exhibit are shown, in diagram form, comprehensive plans and sketches of a Simon-Carvés coke-oven plant, with apparatus for the recovery of tar and ammonia, and of benzenes from the gas, before the latter is burnt in the ovens. There are also to be seen specimens of coke produced from coals of various districts where the Simon-Carvés ovens are being worked.

Other exhibits of interest, under this heading, not in the Chemical Section, are (*Group XVI.*):—

THOMAS FLETCHER, OF WARRINGTON (1534).

Gas-fires and furnaces, burners, etc.

T. J. CONSTANTINE (1536).

Improvements in furnaces for steam boilers, for the consumption of smoke, etc.

ROBERT WALKER (1539).

Patent hydrocarbon furnace without smoke, sparks, or ashes.

FREDERICK SIEMENS (SUCCESSOR TO THE LATE SIR WM. SIEMENS) (1544).

Regenerative gas-furnaces and gas-producers of improved forms, for the manufacture of open-hearth steel and of glass, in a continuous manner (see also this Journal, iv. [7], 439).

C. KINGSFORD (1546).

Steam boiler combined with coke and other ovens for utilising heat hitherto wasted.

———

DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

BRUCE T. T. P. WARREN'S PATENT PETROLEUM (*Group XIV. No.* 1430).

The patent process in question is described in abstract form in this Journal, iii. [9], 475; and in Eng. Pat. 5525, November 26, 1883.

The object of the process is to obtain a neutral and inodorous product from petroleum volatilising at a low temperature without residue. The raw petroleum is repeatedly treated with sulphuric acid, and afterwards the sulpho-acids are carefully removed, and also all moisture. It is then found that the resulting spirit is miscible with chloride of sulphur, without in the least involving its decomposition, a matter of great importance in preparing so-called cold-cured water-proof fabrics. Possessing considerable solvent power, the spirit, it is stated, may be used for all the purposes to which carbon bisulphide is applied; and the fact is pointed out that a poisonous article like carbon bisulphide being replaceable by a harmless one, may be of great advantage to many industries.

Among the articles exhibited, the following are noteworthy:—

Anthracene obtained from the ordinary "crude pressed," without the serious loss entailed by its previous sublimation. This article is almost pure, and bears exposure to light without changing colour.

Elastic Varnishes, coloured with pigments, to show the non-acid character of the solvent.

Inodorous and Quickly-drying Paints, suitable for iron, wood, etc.

Coloured Lacquers, showing its suitability to replace alcohol or similar solvents.

YOUNG'S PARAFFIN LIGHT AND MINERAL OIL COMPANY, LIMITED (*Group XIV. No.* 1426).

Messrs. The Young's Paraffin Light and Mineral Oil Company, Limited, show specimens of the various products made by them. Their exhibit includes samples of shale, crude oil, the various burning and lubricating oils, and candles; they also show a number of extremely handsome lamps, made at their lamp factory at Birmingham.

Among the most interesting of this company's exhibits are two very large and splendid blocks of refined paraffin wax of a pure white colour, and weighing respectively 3cwt. and 7cwt.; also burning oils specially prepared for use in lighthouses and on board steam-ships. These oils have a "flashing point" very much above the Government standard, so that perfect safety is thereby secured. A great variety of lubricating oils adapted for special purposes are also shown.

Of more particular chemical interest is a set of solid paraffins, with melting points ranging from 70° to 150° F. There are also preparations of the various bodies found in crude oil, got by the destructive distillation of bituminous shale; these consist of (1st) a series of paraffins (C_nH_{2n+2}) from heptane C_7H_{16} upwards; (2nd) the phenols and allied bodies removed by treatment with caustic soda; and (3rd) the basic compounds, leucoline, iridoline, etc., prepared from the tar obtained when the crude oil is treated with sulphuric acid.

Among the specimens of special interest exhibited are—

1*st.*—A cylinder of a yellow powder marked chrysene. If this body has been fully proved to be chrysene, its existence amongst the highest boiling constituents of a tar composed so chiefly of paraffins is very interesting, especially if it exist in such apparent quantity, and unaccompanied by other aromatic hydrocarbons, usually found with it.

2*nd.*—A series of products of value obtained by carefully working up the various by-products of this interesting industry; these are—

(i.) *Oxalic acid*, obtained by treating some of the less useful oils with nitric acid.

(ii.) *Alum*, prepared by the action of "spent vitriol" or "acid tars" on spent shale.

(iii.) *Sulphate of ammonia*, very white in colour, is also obtained by the use of "acid tars."

(iv.) *Copperas crystals (ferrous sulphate)*, also obtained by the action of the sulphuric acid of acid tars on spent shales.

The lamps exhibited are beautifully designed, and are excellent examples of the perfection to which these have now been brought. The burners made by this company are specially adapted for burning their oil, and their Duplex and Champion Burners give an illuminating power of 41 and 46 candles respectively. Specimens of miners' lamps recently introduced for burning a specially-prepared paraffin wax in place of oil or tallow, are also shown. For them it is claimed that a better and clearer light is got, while at the same time a considerable economy is effected.

The shales worked now by this company, are from the lower carboniferous formation abounding in the company's works in the counties of West- and Mid-Lothian.

PRODUCTION PER ANNUM.

Shale distilled	500,000 tons.
Crude oil distilled and refined	16,000,000 gallons.
Burning oil produced	6,500,000 ,,
Naphtha	900,000 ,,
Mineral lubricating oil	9,000 tons.
Solid paraffin	6,000 ,,
Candles	4,000 ,,
Ammonium sulphate	4,000 ,,
Number of pits	11
,, ,, employés	3,700
Horse-power of steam boilers	9,000

MESSRS. BURT, BOULTON & HAYWOOD
(*Group XIV. No.* 1428),

Exhibit several large diagrams.

No. 1 shows the principal substances obtained from coal as the result of the manufacture of illuminating gas.

No. 3 represents a wrought-iron tar still containing 2500 to 2750 gallons of tar for a charge.

No. 2 shows the distinctive properties of the more important of the distillates obtained from the tar still, the first rough division of these products being into the three groups,—*oils lighter than water or crude naphthas ; oils heavier than water, or dead oils, heavy oils or creosote oil ; and pitch.*

The distillates are afterwards separated and purified by various processes, and finally a large number of products is obtained, and in this exhibit the ultimate destinations of these products is clearly shown. These are timber preservers, alizarin makers, manufacturers of aniline and other dyes, soap makers, indiarubber manufacturers, manufacturers of sanitary antiseptics, patent fuel makers, manure manufacturers, manufacturers of illuminants, of lubricants, etc., etc.

A complete series of the coal-tar products is shown, both in the condition in which they are prepared for use in the various manufacturing industries, as well as in the form of laboratory specimens of great purity. The inspection of this exhibit would afford a rare opportunity to the student of organic chemistry, comparing the crude materials with the substances as obtained in the pure state ; and by referring to the large diagram above the case, the names, chemical formulæ, boiling and melting points, etc., are found, thus making the comparison a complete one.

Very few chemists will have seen before so magnificent a specimen of chrysene, the very name of which must convey some idea of the difficulty of obtaining it in so pure a state as to take the form of these delicate white plate-like crystals exhibited. The beautiful sample of chrysoquinone ($C_{18}H_{10}O_2$) is also well worthy of special notice. It may be interesting to note here that it was by strongly heating this chrysoquinone with lime that Graebe and Bungener obtained a small quantity of a new hydrocarbon, believed to be phenylnaphthalene. This, taken in conjunction with the fact that the above chemists obtained chrysene by passing benzyl-naphthylmethane through a red-hot tube—

$$\begin{array}{l} C_6H_5-CH_2 \\ \qquad\quad | \\ C_{10}H_7-CH_2 \end{array} = 2H_2 + C_{18}H_{12},$$

would prove that chrysene is a phenylnaphthalene derivative of the formula—

$$\begin{array}{l} C_{10}H_6-CH \\ \quad | \qquad\ \ \| \\ C_6H_4-CH. \end{array}$$

Further light has been thrown on this interesting question by an investigation in which the pyrogenetic method is avoided. This is of quite recent date, and the tendency is so far quite to confirm Graebe and Bungener's conclusions (see Bamberger and Kranzfeld, *Ber.* 18, 1931). Another rarity is to be seen in the finely-crystallised specimen of acridine hydrochloride (fine golden flakes) ; and here is also to be seen a large specimen of pure acridine. As an example of a liquid exhibiting fine blue fluorescence, attention is called to the specimen of a solution of dichloranthracene sulphonic acid. Messrs. Burt, Boulton & Haywood are also large importers of timber, and this they prepare by the creosoting process. The creosote used consists of those crude oils which are intermediate between the so-called "heavy oils" of tar, and the "green or red oils" from which the crude anthracene is obtained. Timber preserving was the original industry of this firm, and before finally settling down to the sole employment of the creosoting process they had tried a number of others, such as those involving the uses respectively of sulphate of copper, chloride of zinc, and mercuric chloride, etc., all of which materials were found inferior to the first. Diagrams 4 and 5 show experiments in illustration of Mr. S. B. Boulton's patent, No. 1954, 1879, for improvements in the process of timber preserving, and an excellent model is shown under glass of the apparatus for carrying out this process (see this Journal, iii. [12], 622, and *Journal of Institute of Civil Engineers* for May, 1884). The exhibits, as well as the data given, show that when properly treated by this process, the resistance of timber to all influences which decay or rot, as well as to the devouring attacks of marine and land insects, is almost unlimited. Any causes of failure in the use of the creosote may be invariably traced to one of two causes : 1st, to the neglect of the absolutely essential precaution of divesting the timber of moisture before injecting the creosote under pressure ; 2nd, to the exclusive use of a too light, thin or volatile description of creosote. Experience has shown that such volatile oils rapidly disappear from the timber, and that the efficacious agents of preservation are the constituents of the heavier portions of the creosote.

THE BRITISH ALIZARIN COMPANY, LIMITED
(formerly MESSRS. BURT, BOULTON & HAYWOOD)
(*Group XIV. No.* 1427).

The specimens exhibited are not only of the greatest present interest, but as illustrating the history of the development of the madder and alizarin industries it is an absolutely unrivalled exhibit.

Firstly, There is a series of specimens illustrating the growth and form of the madder plant and various dyeing products derived from it. Amongst these is a living specimen of the madder plant *(rubia tinctorum)*.

Secondly, A series of specimens illustrating the old processes of painting, dyeing, and printing from the products of madder and munjeet.

Thirdly, Series of products illustrating the processes of manufacture of alizarins, flavo-purpurins, and anthrapurpurins from anthracene (see the President's Address, July number, pages 432-434).

Fourthly, Numerous specimens of printed and dyed cottons, muslins, velvets, cretonnes, etc.; also specimens of dyed Turkey-red cloth and yarn, all dyed with the products from coal-tar anthracene. Some of these specimens show alizarin in conjunction with other colouring matters.

Readers interested in this subject are referred to this Journal, iii. [12], 594; and iv. [1], 18, where full accounts by Professor Hummel, of Leeds, on dyeing wool with alizarin colours, and by Mr. Sansone, of Manchester, on dyeing cotton with the same, will be found.

The Alizarin Industry was commenced in England by Messrs. Perkin Bros., in 1869, and about the same time in Germany, where quite another process was used. In 1874 Messrs. Perkin ceded their works at Greenford, with their patents, to Messrs. Brooke, Simpson & Spiller, who in 1876 sold them to Messrs. Burt, Boulton & Haywood. The latter firm considerably extended the manufacture, the seat of which was removed to Silvertown, where larger works were erected. In 1883, at the time of the expiration of the patents, the large consumers of alizarin in this kingdom became desirous of ensuring a regular supply of alizarin of British manufacture. A committee was formed of the largest Turkey-red dyers and printers of the Glasgow and Manchester districts, who arranged with Messrs. Burt, Boulton & Haywood for the purchase of their Silvertown works, where this manufacture is now carried on by a company formed for that purpose, and this is the British Alizarin Company, Limited (see Mr. Levinstein's paper at the Manchester Section, this Journal, ii. [5], 213, 220, 226).

The following statistics relating to this industry are furnished :—

"During the 15 years ending 1870 the average value of imports of madder and madder products into the United Kingdom amounted to £1,000,000 sterling per annum. It has never fallen to less than £30,000 per annum. But the new alizarin has not only replaced the madder root, it has done much more. At the present time three distinct bodies are recognised as forming the principal colouring matter of these dyes—viz., alizarin, anthrapurpurin, and flavopurpurin, which give distinct varieties of shades. The knowledge of this fact enable the manufacturer so to vary his process of production as to enable him to supply the consumer with different brands of the colouring matter capable of producing a variety of recognised shades. Again, the increased and uniform tinctorial strength of the perfected colour, and its freedom from wood-fibre, grit, and other impurities, are enormous advantages to the dyer and printer. Very important improvements in the art of calico-printing and Turkey-red dyeing have been thus rendered practicable, and styles can be produced which were impossible with the madder products. A great increase in these industries has taken place since 1870. The average yearly consumption of alizarin in Great Britain may now be calculated at 3400 tons of 20 per cent., the strength at which it is now sold, or 6800 tons of 10 per cent. Now, according to the best authorities, a ton of 10 per cent. alizarin does the work of 9 to 10 tons of madder root. Taking the lowest computation, therefore, the 6800 tons of alizarin at present consumed annually in these islands represent 61,200 tons of madder."

The cost of 61,200 tons of madder, at the average prices of the 15 years ending 1870, would amount to the enormous sum of	£2,907,000
The cost of 6800 tons of alizarin, at the present market price, amounts to ...	456,960
Therefore, in addition to other advantages, a saving is effected to the textile manufacturers of this kingdom, per annum, amounting to	£2,450,040

The consumption of alizarin in the United Kingdom is about equal to that of the whole of the rest of the world.

MANUFACTURE OF PRODUCTS FROM COAL.

Mr. George E. Davis (Messrs. Newton, Chambers & Co.) (*Group XIV. No.* 1467).

Mr. Davis carbonises coal in retorts similar to those used in gas works, and he refrigerates the illuminating gas, which latter is then scrubbed by being passed through oils cooled to 4° C. In this way he claims a more rapid and perfect extraction of the benzenes from the gas than when refrigeration is not used (see this Journal, ii. 372, 515; also iii. 369 and 433). For the refrigeration a No. IV. Linde ice machine is used, and this is also employed in preparing pure benzene and carbolic acid. In the specimens exhibited, the 97 per cent. metaxylene necessary for the preparation of xylidine for the manufacture of scarlet dye, and the sulphocyanide of ammonium prepared from waste liquors, deserve special notice.

THE DISTILLATION OF SHALE, Etc.

Messrs. Wm. Young and G. Beilby (*Group XIV. No.* 1467; *and XV. No.* 1486).

Messrs. Young and Beilby, of the Oakbank Oil Company, Midcalder, exhibit apparatus used in the distillation of shale. The first section includes especially appliances for the production of fuel-gas, and among these, retort gas-producers for the manufacture of heating-gas and ammonia, with also gas-condensers and scrubbers.

The exhibit relating to paraffin oil manufacture comprises :—1. Retorts for the distillation and treatment of shale for the production of paraffin oils and ammonia. 2. Stills for the continuous and fractional distillation and fractional condensation of paraffin oils. 3. A new form of gas or air thermometer, suitable for stills and condensers. 4. Apparatus for cooling paraffin oil for the crystallisation and separation of solid paraffin.

Fuel Gas Production.—Messrs. Young and Beilby have for some years been engaged in working out a practical process by which a larger proportion of the nitrogen of coal may be obtained as ammonia. Under Young and Beilby's system coal is first distilled in a current of steam, and the coke, or carbonaceous residue, which retains about 60 per cent. of the nitrogen, is burned in a mixture of steam and air, the former being in such large excess as to preserve from decomposition the ammonia derived from the nitrogen of the coke. When this process is properly carried out ammonia is produced equal to from three-fifths to four-fifths of the nitrogen of the coal, or from three to four times as much ammonia as is produced by the most efficiently performed destructive distillation.

It must be noted that this result can only be obtained by the partial or total consumption of the carbonaceous residue, so that the process is applicable to the production of gas rather than coke, from coal. It is believed by the inventors that the great future of the process will be as a gas-producing system, since one-half of the fixed carbon of the coal is oxidised by the oxygen of steam setting free an equivalent amount of hydrogen. The gas obtained is very much richer in hydrogen than ordinary producer gas, and is therefore a more valuable fuel. Comparative analyses of the gas from a Wilson producer and from Young and Beilby's retorts give the following results :—

	Wilson Gas.	Y. and B. Gas.
Carbonic acid	7·14	15·40
Hydrogen	12·15	34·53
Carbonic Oxide	19·83	10·72
Marsh Gas	3·91	4·02
Nitrogen	57·24	35·33
	99·97	100·00

The models and drawings exhibited illustrate two forms of retort gas-producer. The first form is designed for supplying the heat to shale retorts. It consists of a vertical retort built of brick, closed by a door at the top, and provided with an exit pipe which connects the retort with a system of mains and condensers. At its lower end the retort terminates in a closed fireplace and ashpit, with regulating doors or dampers. The dross or small coal is introduced by the top door, and, resting on the firebars, fills the retort from top to bottom. The upper part of the retort, being surrounded by flues through which fire gases are led, is kept at a full red heat. The coal at this part of the retort is distilled, and parts with gases and vapours which pass away by the exit pipe to be cooled and condensed. As the coke passes down in the retort it is met by a current of steam, which is partly decomposed, burning the carbon, and producing ammonia and "water gas," which pass off along with the other volatile products. When such a coke as has escaped the action of the steam reaches the firebars, it is turned into carbonic oxide by a regulated admission of air. This red-hot carbonic oxide passes off by ports at the lower end of the retort, and is burned in the flues surrounding the shale retorts. The gases from the upper part of the retort, after having been deprived of their condensable constituents, are also returned and used in firing the retorts. By this system of firing, less fuel is used than by the open furnace, and the ammonia and tar recovered from the coal more than pay its first cost. About 200 of these retort producers are in use in Scotch oil works.

The second form is for the production of gas for firing steam boilers or for metallurgical operations. The shell of the retort is built of grooved bricks as before, but it is of circular section, and of much larger diameter than the early retorts. The top is closed by a shallow hopper of cast iron, with two small charging doors; through the centre of this hopper a large iron pipe is led half-way down the retort. This pipe is for the exit of the gases, and passes up into a large dust-box which runs along the bench. From the dust-box the gas is conveyed by large pipes to the condensers and exhauster. The bottom of the brick retorts rests on an iron snout-piece, which is provided with a door at the outside of the setting. The steam and air are blown in at the front of this snout-piece. The gas and air for heating the setting are led up by pipes between the walls of the building, and are thereby heated before they take fire. The fire gases surrounding the retorts are drawn downwards by chimney draughts, and before entering the main flues at the bottom of the setting they give up their heat to the iron snout pieces, through which the steam and air are entering.

Gas Condensers and Scrubbers.—In carrying out the process of gasifying carbonaceous residues in excess of steam, a great deal of heat is carried away from the operation by the large quantity of gas produced. To recover a part of this heat, and to make it again available in the process, certain forms of regenerative condenser have been devised. In these the hot gases from the retorts pass through tubes which are immersed in water or are kept wet by a shower or spray of water. The tubes are enclosed in a box or case through which a current of air is forced. The air becomes saturated with water vapour to an extent depending on its own temperature and that of the wetted tube surface. This saturated air, by the further addition of steam, is available for the incineration of the coal in retort gas-producers. As the principal outlay of heat in the vaporisation of water is that portion which is latent in the steam, the economy of this method of producing water vapour from heat of comparatively low grade is very evident. Air at 150° F. takes up one-fourth of its weight of water, at 165° one-third, at 175° one-half, at 185° an equal weight, and at 200° twice its weight; it is therefore possible to raise into vapour large quantities of water by means of a comparatively small volume of air. Condensers of this construction have been working satisfactorily in the Clippens Company's Works at Pentland for nearly two years.

Paraffin Oil Manufacture.—The production of paraffin oil from shales and cannel coals by distillation at a low red heat may be said to date from 1850, when Mr. James Young applied for his celebrated patent. Since then the process of shale distillation has passed through three well-marked phases. During the first phase the so-called "low-red heat" was, in actual practice, more nominal than real. Retorts of small capacity were used, and in order that they might exhaust a sufficiently large quantity of shale in a given time, the metal of the retort was raised to a very bright-red heat, such a heat that the life of a retort was only from six months to a year. The crude paraffin oil produced by these retorts was black and tarry, and contained only about eight per cent. of solid paraffin.

The second stage dates from 1867, when Mr. William Young designed retorts with the express object of working them really at a low-red heat. By this improved system crude oil of much greater purity, and containing 10 per cent. to 11 per cent. of solid paraffin, was produced. Although the advantages of this system of working were clearly shown in 1868, the necessary plant was only perfected in 1873, when Mr. N. M. Henderson patented the retort which bears his name. In this retort the principle of low-red heat distillation was practically realised, and in addition the residual carbon of the exhausted shale was used as fuel for heating the retorts.

The third phase dates from 1881, when Messrs. William Young and George Beilby patented their process for the distillation and treatment of shale. By this system shale is first distilled at the low-red heat most suitable for the production of paraffin oil, after which the coke or residue, instead of being used merely as fuel, is incinerated in an atmosphere of steam and air so that the nitrogen is obtained as ammonia, the residue being discharged from the retorts as an ash. In the upper parts of the retort the shale is distilled yielding crude paraffin oil. The exhausted shale is then drawn down into the lower parts in which the fixed carbon is burned in steam or steam and air, the nitrogen being obtained as ammonia, and the shale being reduced to ash. The

following figures show the influence of the new process introduced in 1881. There are at present in course of erection, or in actual use, about 2000 retorts capable of distilling and treating under the new system 750,000 tons of shale per annum. Among the companies which have adopted these retorts are:—Young's Paraffin Light Co., The Clippens Oil Co., Oakbank Oil Co., Pumpherston Oil Co., West-Lothian Oil Co., Dalmeny Oil Co., etc. The admitted gain of sulphate of ammonia, by the new process, is not less than 14lb. per ton of shale, or 4687 tons per annum, which, at £10 per ton, is equal to £46,870. But, in addition to this gain of ammonia, there is also an increased yield of solid paraffin valued at about £40,000 per annum. As the costs for labour, fuel, and maintenance of the new retorts do not exceed those incurred under older systems of working, the whole of the above saving of £86,000 may be credited to the new process.

Stills for the continuous and fractional distillation and condensation of paraffin oils are also shown. Fractional distillation plays a most important part in the refining of crude paraffin oils. Hitherto fractional condensation, which has been so successfully employed in the rectification of alcohol and of benzene, and of other substances of comparatively low boiling point, has not been used for the separation of oils of high boiling point, such as the burning and lubricating paraffin oils, which boil at from 212° to 800° F. The still is a long cylindrical boiler, partitioned so that oil fed in at one end follows a tortuous course in reaching the opposite end. Each partitioned space is provided with a separate off-take pipe and set of condensers. The oil as it flows from space to space parts with its successively less volatile portions until it reaches the end space, from which it is removed as a thick residue. The greatest heat is applied at the end from which the residue passes, while the partially spent heat is applied at those parts of the still containing oils of lower boiling point. The tubular condensers are kept at temperatures just sufficiently low to condense oils of the particular volatility it is desired to retain, so that the vapours of the more volatile oils pass onwards to successive condensers to be further differentiated.

Besides the foregoing, Messrs. Young and Beilby exhibit a new form of gas thermometer suitable for oil, stills, and condensers. Thermometers are required for the regulation of the temperature of stills and condensers for the fractionation of paraffin oils. As a large proportion of these oils boil at temperatures above the boiling point of mercury, Mr. Beilby has been led to construct a gas or air thermometer by which temperatures up to and beyond the softening point of glass can be readily observed. This instrument was recently described by the inventor in a paper read before the Society of Chemical Industry (see this Journal, vol. iv. page 40). The parts common to the various forms of the instrument are: (1) A bulb or expanding vessel filled with dry air or other suitable gas; (2) A measuring tube in which the air expelled from the bulb is measured at constant temperature and pressure; (3) A connecting tube of comparatively small capacity between the bulb and the measuring tube; (4) A jacket or casing surrounding the measuring tube in which steam, water, or other medium is contained or circulated so that the temperature of the measuring tube is maintained at a constant known temperature; (5) A pressure regulator by which the air or gas within the apparatus is maintained at a constant pressure. The graduation of this thermometer is very different from that of an ordinary mercurial thermometer. As every increment of temperature expands the gas in the bulb, a corresponding portion is expelled into the measuring tube; but every portion so expelled reduces the mass of the gas in the bulb so that successive equal increments of heat cause the expulsion of decreasing amounts of gas, therefore the degrees diminish in length as the temperature rises.

There are also some interesting apparatus for cooling paraffin oils for the crystallisation and separation of solid paraffin. While fractional distillation is a most valuable and useful process for the separation of oils of different boiling points, the separation of the solid from the less volatile liquid paraffins cannot be so effected, as these distil over together. If, however, the solution of solid paraffin be lowered in temperature, the paraffin crystallises out, and may be separated from the solvent oil by straining or filtration. In applying artificial cooling for the separation of solid paraffin from oil, it has hitherto been the custom to reduce the temperature of the solution quickly by running it over a cold metallic surface, the solidified film being scraped off in a pasty state. The effect of this sudden cooling is to make the paraffin amorphous or imperfectly crystalline, so that it is only with difficulty separated from the oil. The system adopted in Beilby's apparatus is the slow regular cooling of the solution, so that large, or at least well-formed crystals are produced. A further feature in the apparatus is the saving of manual labour in crushing the mass of solidified oil and paraffin after it has been cooled. The vessels in which the oil is cooled are rectangular cells 16ft. long, 8ft. deep, and 1ft. in width. A number of these cells are built up together in blocks, say of ten cells each. Between each pair of oil cells is an interspace or intermediate cell through which cold brine or cold air is circulated. Four days is the time required thoroughly to cool and crystallise the cell full of oil. At the end of that time the cell contains a solid slab of oil and paraffin 16ft. long, 8ft. deep, and 1ft. thick. The crushing and shearing strength of the slab is about 3lb. per square inch. The slab has to be mashed down so that it can be withdrawn from the cooling cell by the ordinary filterpress pumps. To provide for this each cell has a screw lying in the bottom along its whole length of 16ft. The diameter of the screw is 1ft., so that it occupies the full width of thickness of the cell. A central shaft on which the screw is keyed projects through a stuffing gland on one end of the cell, and can be rotated by worm gearing. By rotating this screw the slab of paraffin is sheared or bored away along its whole length, the sheared or mashed paraffin being thrown by the screw through a sluice valve at the opposite end from the driving gear. As the bottom of the slab is sheared away and discharged, the weight of the whole mass causes it to follow down on to the screw, until the slab is completely sheared away. This downward slipping of the slab is favoured by making the cells rather wider at the bottom than the top. Complete plant according to this system has been erected at Oakbank Works, Midcalder, for the cooling of 8000 gallons of oil and paraffin per day.

MANUFACTURE OF SULPHATE OF AMMONIA.

R. R. Kelly, London (*Group XIV. No.* 1453),

Exhibits specimens of raw materials and products in this manufacture.

MANUFACTURE OF PATENT CARBOLIC POWDER FOR DISINFECTANT AND OTHER PURPOSES.

Jas. B. Austin, Bristol (*Group XIV. No.* 1461).

REFRIGERATING APPARATUS.

J. J. Coleman (*Group XIV. No.* 1429)

Exhibits a model of the well-known refrigerating apparatus of the Bell-Coleman Company, so arranged that by an accumulator the cold air can be reduced to 120° below zero F., at which temperature carbonic-acid gas can be liquefied continuously in a coil without pressure above that of the atmosphere, and ethylene and marsh gas at very moderate pressures, as mentioned in Mr. Coleman's "Address to the Chemical Section of the Philosophical Society," reported in the *Chemical News*, April 10, 1885, page 175. This arrangement of apparatus is also substantially the same as was employed for some years on a very large scale at the Bathgate Works of the Young Paraffin Light and Mineral Oil Company, Limited, where the waste gases of the oil works were compressed by a pressure of 120lb. to the square inch, thus separating some volatile liquids, after which the residual gas was expanded in doing the work of compressing fresh portions of gas—the ejected cold gas being employed in cooling that which has been compressed previously to its arrival at the expansion cylinder, by which a second crop of very volatile liquids was obtained. (See *Journ. Chem. Soc.* 1875, 856; also this Journal, iii. 357, 613, 614; also iv. 323 and 325.)

Dr. C. A. Burghardt, of Manchester (*Group XIV. No.* 1467),

Exhibits a model of a condensing apparatus for volatile liquids, or rather for condensing and recovering the vapours of such volatile liquids as are used, for example, by the indiarubber manufacturer in vulcanising and in waterproofing, etc., and which are generally allowed to escape, rendering the atmosphere of the factory noxious for the workpeople, dangerous for fires or explosions, and generally a source of loss.

In the woodcut the twelve transverse lines marked A represent the sheets of wire-gauze, B representing the annular condensing space. When this apparatus is employed for recovering naphtha used in indiarubber manufactories, a blower is employed to drive the vapour in, and with water at 55° F., 30 to 35 per cent. of the naphtha used in the machine can be recovered. If artificial cold be employed and the temperature reduced to 35° F., then 60 to 70 per cent. of the naphtha can be regained. These condensers are also being used successfully to take the place of worm-coils, etc., in ordinary distilling operations.

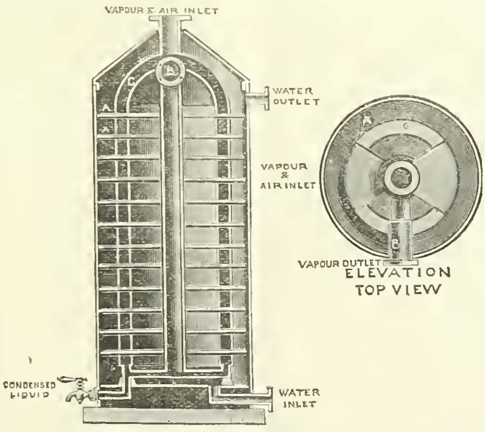
Messrs. F. C. Calvert & Co. (*Group XIV. No.* 1466)

Exhibit specimens illustrating the various stages of the manufacture of carbolic acid of a melting point of 42° C. from coal-tar oils, as well as the various rectifications of the liquid carbolic acid, consisting principally of cresol and other homologous phenols.

This firm also exhibits a series of sulpho-phenates of various metals, the salts being very finely crystallised.

A number of dye-stuffs obtained from phenol is also shown, especially new blue and yellow dyes, the effects of which are shown both in printed and dyed specimens. These colours are said to possess very considerable resistance both towards light and soap. The new colours are termed "Azuro-" and "Auro-phenylene," respectively, and are quite extra to the aurin and picric acid for which, with the pure phenol and the phenol hydrates discovered by Mr. Chas. Lowe, this firm has so long been famous. (See Eng. Pat. 5458, March 26, 1885.)

There is, further, a new red or crimson dye named "Rosophenylene,"—a pararosaniline derivative,—also patented by Mr. Lowe. The "Azuro-phenylene" is a derivative of the old Azuline of M. Marnas, and the Auro-phenylene is a nitro-derivative of this latter.



ELEVATION
TOP VIEW

The model exhibited is not on a reduced scale, but actually represents the invention in working dimensions. It is declared by the inventor to act most efficaciously in condensing to the liquid form all vapours of naphtha, bisulphide of carbon, and the like. Annexed is a woodcut, showing the principle of construction of this small column condenser, which resembles in appearance, as well as to some extent in structure, a small dephlegmating column.

MANUFACTURE OF BENZENE COMPOUNDS FROM THE BENZENE OF COAL-GAS.

Messrs. Sadler & Co., Middlesbrough (*Group XIV. No.* 1467).

Since 1862 various attempts have been made to extract benzene from coal-gas, but although processes with this object have even been worked on a large scale, yet the great variations in the price of benzene

seem to have prevented their continuous successful operation since the time they were first originated.

Leigh, in 1863, patented the manufacture of nitrobenzene by passing coal-gas through nitric acid or nitric acid mixed with sulphuric acid; and in 1869, Messrs. Caro, Clemm, and Engelhorn patented a process for extracting benzene from gas by means of heavy oils, which latter were made to pass through the ordinary coal-gas scrubbers or washers. This process was worked on a large scale by the inventors for a time.

The manufacture of nitrobenzene from coal-gas appears never to have been successful. This is due in great measure to the fact that in ordinary coal-gas there are hydrocarbons present which by reacting with the nitric acid form water. The acid mixture then becomes too dilute to absorb the benzene. When gases are used which contain only a small proportion of benzene a considerable volatilisation and loss of nitrobenzene and nitric acid takes place. Besides these difficulties it was found that the nitrobenzene actually obtained was far from pure, other liquid nitro-compounds being formed at the same time.

In 1881, Mr. Kendall patented the manufacture of dinitro-benzene from coal-gas (see this Journal, i. [4], 143; and [11], 444). This product being non-volatile and easily crystallisable, could be obtained in a pure state without difficulty. In this process the gas is first purified by passing it through concentrated sulphuric acid, and it is then passed into a mixture of nitric acid with an excess of sulphuric acid. It was found that when suitable coal-gas was used, the whole of the benzene could thus be extracted with facility and economy. Mr. Kendall's second process was patented in 1882. By submitting coal-gas to a "superheating" process in red-hot retorts, it was found that the amount of benzene could be largely increased, while at the same time the objectionable hydrocarbons before alluded to could be destroyed. As consequences of this discovery, it became possible in the first place to manufacture pure nitrobenzene direct from coal-gas, and in the second place, it was found that almost any variety of coal-gas, including that from coke-ovens, could be used for the purpose. In dealing with such crude gases it will be obvious that the ordinary nitric extraction method will be inapplicable, and only a very partial extraction of the benzene can be effected by the ordinary oil process. But by destroying the interfering hydrocarbons and simultaneously increasing the percentage of benzene, the gas is rendered quite suitable for the chemical methods before described.

Messrs. Sadler & Co., of Middlesbrough, are carrying on the entire process of making coal-gas and extracting the benzene in the form of nitro compounds by the above processes, the "spent" gas being used for heating purposes.

They exhibit specimens of nitro- and dinitrobenzene prepared by the processes named.

MANUFACTURE OF AURIN.

Messrs. Roberts, Dale & Co., of Manchester (*Group XIV. No.* 1467).

This firm exhibits (1) Specimens of aurin; (2) A series of samples of constituents with derivatives of American petroleum prepared and separated for the first time by Prof. C. Schorlemmer, F.R.S., of Manchester.

Though the specimens in this exhibit are neither large, nor in any way striking to the eye, yet associated with the names of Schorlemmer, and Dale and Schorlemmer, they at once become invested with a high degree of interest, both for the theoretical chemist and the chemical technologist.

Turning to the aurin specimens, illustrating the researches of R. S. Dale and C. Schorlemmer, we find the crude article and the pure crystalline substance, and, besides, various aurin derivatives. Certainly the most remarkable, and for the technological chemist the most interesting, is pararosaniline, first prepared by Dale and Schorlemmer from aurin by simply heating the latter with aqueous ammonia in sealed tubes to 200° C., the following simple reaction then taking place:

$$C\begin{cases} C_6H_4.OH \\ C_6H_4.OH \\ C_6H_4 \diagdown \\ \quad O \diagup \end{cases} + 3NH_3 = C\begin{cases} C_6H_4.NH_2 \\ C_6H_4.NH_2 \\ C_6H_4 \diagdown \\ \quad NH \diagup \end{cases} + 3H_2O.$$

Aurin. Pararosaniline.

This remarkable transformation by Dale and Schorlemmer laid the foundation for the work of Messrs. E. and O. Fischer, who subsequently proved that aurin, and consequently pararosaniline, are substituted derivatives of the hydrocarbon triphenylmethane, the simplest analogue of which is common marsh-gas (methane), CH_4. E. and O. Fischer, for the above purpose, first converted aurin into pararosaniline, according to the method of Dale and Schorlemmer. Pararosaniline was then reduced to paraleuco-rosaniline, the latter after conversion into its nitrate was diazotised, and the diazotriphenylmethane nitrate thus obtained. After converting the nitrate into the acid sulphate by treatment with sulphuric acid, which is easily effected, the acid sulphate was boiled with alcohol. Thus, a hydrocarbon was obtained which was found to be in every respect identical with triphenylmethane, otherwise prepared. (See President's Address, this Journal, iv. 429, 431, and 435.)

Messrs. Brooke, Simpson & Spiller, of The Atlas Works, Hackney Wick (*Group XIV. No.* 1467),

Show a collection of about eighty specimens illustrating the manufacture of coal-tar colours and products applicable to dyeing and printing.

These consist not only of the finished articles, some of which were actually discovered by the firm, but include a series of chemical products arising out of such manufacture or incidental thereto.

The exhibitors claim the production of a variety of colouring matters of uniform strength and shade, and of superior quality as regards purity. The consumer may also glean information regarding the effects of the various dyestuffs on the fibre, for around the neck of each bottle is arranged a skein of silk dyed with some of the contents.

The following are exhibited:—

Large bottles of—

Coal tar, Orthotoluidine, Pure aniline,

With specimen bottles containing—

Benzene	Non-mordant cotton blue
Nitrobenzene	6 B., Fast blue
Binitrobenzene	Dragon green
Diphenylamine	Hofmann violet, 2 B.
Paratoluidine	Methyl violet, 6 B.
Naphthalene	Phosphin
β-Naphthol	Primrose
β-Naphthylamine	Fast yellow
Benzoic acid	Albany
Rosaniline base	Citronine
Golden roseine	Atlas orange
Regina purple	Pure scarlet
Pure opal blue	Atlas scarlet
Pure soluble blue	Safranin
XL Soluble blue	Eosine, y. s.

Fast pink
Sloeline, b. s.
Bismarck brown
Nitrochlorbenzene
Metadinitrobenzene
Metatoluylenediamine
Paracetoluid
Metanitroparacetoluid
Metanitroparatoluid
Orthoacetoluid
Tropæoline, OO
Citronine sodium salt
Rosaniline base, crystallised
Orthorosaniline
Pararosaniline
Pararosaniline hydrochloride
Xylidine red
Triphenylorthorosaniline hydrochloride
Triphenylpararosaniline hydrochloride
Triparatolylorthorosaniline hydrochloride
Triparatolylpararosaniline hydrochloride
Methyl violet zinc chloride
Helianthin
Helianthin (acid)
Acid maroon
Resorcinol
Phthalic anhydride
Aniline oxalate
Aniline sulphate
Chrysoidine crystals
Chrysoidine sulphonic acid
Sulphanilic acid
α-Naphthalene sodium sulphonate
β-Naphthalene sodium sulphonate
Diphenylamine opal
Alkaline green
Indulin opal

Finally, a specimen of—

Aniline, prepared from indigo,

at first the only known source of it. (See President's Address, this Journal, iv. 428 and 429.)

———

ANILINE AND NAPHTHOL-COLOURS AND RAW MATERIALS.

I. Levinstein & Co., of Manchester (*Group XIV. No.* 1462).

The following is a numbered list of the colouring matters and dyes, together with the raw materials and intermediate products, manufactured by this firm. In the United States, the firm bears the title of Levinstein, Campbell & Co., and enjoys there the same well-merited reputation as in this country. The exhibit, as a whole, is equally well calculated to instruct the student of applied chemistry in an examination of the specimens shown, as it is to interest the intelligent consumer or the technologist, for not only the final products, the dyestuffs themselves, are exhibited, but also the materials forming the starting points, as well as the intermediate products forming the steps. In handsome specimen cases, skeins of dyed cottons and silks are also to be seen.

The following is the numbered list of specimens exhibited, followed by some details of more special interest, from information kindly furnished by Mr. Levinstein:—

1 Benzene
2 Toluene
3 Xylene
4 Nitrobenzene
5 Nitrotoluene
6 Nitroxylene
7 Aniline
8 Orthotoluidine
9 Xylidine
10 Cumidine
11 Monomethylaniline
12 Dimethylaniline
13 Mono-ethylaniline
14 Diethylaniline
15 Diphenylamine
16 Aniline nitrate
17 Toluidine nitrate
18 Xylidine nitrate
19 Nitrotoluidine
20 Nitrotoluidine hydrochloride
21 Nitroxylidine
22 Nitroxylidine sulphate
23 Amidoazobenzene
24 Binitrobenzene
25 Binitrotoluene
26 Metatoluylenediamine
27 Sulphanilic acid
28 Barium sulphanilate
29 Ammonium amidoazobenzene sulphonate
30 Potassium amidoazobenzene sulphonate
31 Sodium amidoazobenzene sulphonate
32 Amidoazobenzene disulphonic acid
33 Benzaldehyde
34 Resorcinol
35 Phthalic anhydride
36 Phenosafranin
37 Tolusafranin
38 Leuco-malachite green
39 Leuco-ethyl green
40 Naphthalene
41 Nitronaphthalene
42 α-Naphthylamine
43 β-Naphthylamine
44 α-Naphthalene sulphonic acid
45 Sodium α-Naphthalene sulphonate
46 Sodium β-Naphthalene sulphonate
47 Sodium β-Naphthalene sulphonate
48 α-Naphthol
49 β-Naphthol
50 α-Naphthylamine sulphonic acid
51 Magnesium α-Naphthylamine sulphonate
52 Barium α-Naphthylamine sulphonate
53 Zinc α-Naphthylamine sulphonate
54 β-Naphthylamine sulphonic acid
55 Sodium β-Naphthylamine sulphonate
56 Calcium β-Naphthylamine sulphonate
57 Barium α-Naphthol disulphonate
58 Calcium nitroso-α-naphthol sulphonate
59 Calcium salt of naphthol yellow
60 Ammonium-calcium salt of naphthol yellow
61 Potassium-calcium salt of naphthol yellow
62 Sulphonic acid of naphthol yellow
63 Ammonium salt of β-naphthol sulphonate
64 Potassium salt of β-naphthol sulphonate
65 Sodium salt of β-naphthol sulphonate
66 Barium salt of β-naphthol sulphonate
67 Anthraquinone
68 Sodium anthraquinone mono-sulphonate
69 Saffranin
70 Chrysoidine
71 Methylchrysoidine
72 Dimethylchrysoidine
73 Brown Y.
74 Brown R.
75 Orange Y.
76 Orange R.
77 Scarlet G.
78 Printing scarlet
79 Xylidine scarlet
80 Cumidine
81 Vermillion 2B.
82 ,, xB.
83 Roccellin
84 Scarlet A.
85 Malachite green
86 Brilliant green
87 Synthetic rosaniline
88 Purple I.
89 Blue I.
90 ,, II.
91 ,, III.
92 Opal blue
93 Alkali blue R.
94 ,, B.
95 ,, 2B.
96 ,, 4B.
97 ,, 5B.
98 ,, 6B.
99 Violet B.
100 ,, 2B.
101 ,, 3B.
102 ,, 5B.
103 Eosin
104 Saffrosin
105 Hexanitrodiphenylamine orange
106 Naphthol yellow

———

3. Xylene.—This firm has a cheap method for producing metaxylene from commercial xylene. That there are difficulties in the way of a smooth passage on the practical scale from metaxylene into xylidine, will be evident from the following facts. If pure metaxylene be converted into its nitro-compound, and afterwards the latter be converted into the amido-derivative, the reaction proceeds on the large scale in a manner analogous to that by which benzene is converted into aniline, but if the metaxylene contain only a few per cents. of orthoxylene, tarry matters are at once formed, hindering the practical formation of the xylidine. The improvement in question is one by which this difficulty is avoided, the methods known to science being too expensive. At the present time the price of xylidine is not more than 1s. 2d. per lb., which fact is certainly a criterion as to the successful manner in which metaxylene is extracted from commercial xylene, and afterwards converted into xylidine on the large scale by the present most improved methods of working.

10. Cumidine.—As a special feature in this preparation, as carried on in Messrs. Levinstein's Works, may be mentioned an improvement in the method of methylating xylidine so that enamelled autoclaves need not be used. These enamelled autoclaves are expensive articles, and when worn through they cannot be re-enamelled in England. The improvement consists principally in using sulphuric in place of hydrochloric acid, when un-enamelled cast-iron vessels may be used.

16, 17 AND 18. ANILINE, TOLUIDINE AND XYLIDINE NITRATES.—The materials used in preparing these salts are so manipulated that the formation collaterally of nitro-products is prevented.

19, 20, 21, 22. NITROTOLUIDINES AND XYLIDINES.—No simple method was at first known for converting such aromatic bases as aniline, toluidine, xylidine, naphthylamine, etc., into nitro compounds. This problem has now been solved (Ger. Pat. 30,889), so that it is at present both easy and profitable to make tons daily of these hitherto rare preparations. Especially is the practical value of this method exhibited in one specimen—viz.:

METATOLUYLENEDIAMINE OR β-DIAMIDOTOLUENE (1, 3, 4—CH_3 in 1), see list, No. 26. This is produced by reduction of the corresponding nitrotoluidine, and also by that of colouring matters made from the former. Specimens of such colours are Nos. 71, 72 and 74, which are distinguished by their great purity.

38 AND 39. LEUCOMALACHITE GREEN AND LEUCOETHYL GREEN.—As is generally known, "malachite green" owes its formation to the interchange reaction between dimethylaniline, $C_6H_5N(CH_3)_2$, and benzyltrichloride, $C_6H_5.CCl_3$, in presence of zinc chloride. Zinc chloride forming a difficultly-soluble double salt with the basis of "ethyl green," is also used in presence of hydrochloric acid for precipitating, in the crystalline form, the colouring matter bearing that name.

In the new method of condensation employed, in the case of neither of the above-mentioned dyestuffs is zinc chloride made use of. Specimens are shown of the zinc chloride double salts, of the hydrochlorides of the tetramethyl- and tetraethyl diamidotriphenyl-carbinol, and the oxalates of the latter. The oxalate of the ethyl green base is a beautifully crystalline preparation.

48 AND 49. α- AND β-NAPHTHOLS.—In the usual process for the manufacture of the naphthols, the respective isomeric naphthalene sulphonic acids are fused with *excess* of caustic soda, the result of the fusion being the formation of the sodium salts of the respective naphthols. These have to be dissolved, and the naphthols precipitated with an acid. Now, since an excess of caustic soda is always used in the fusion process, also an excess of acid is required, firstly, to neutralise the free alkali; secondly, to decompose the sodium naphthol salt; and, thirdly, to decompose, with evolution of sulphurous acid, the sodium sulphites which are the result of the fusion of the α- and β-naphthalene sulphonic acids with the caustic soda; it will be plain that there is here room for economic improvements. Such an improvement Messrs. Levinstein & Co. have with great ingenuity effected. It is embodied in Eng. Pat. 2300, 1883, and consists in heating the mixture of excess of caustic soda and sulphonic acid in the fusing process very gradually, when, at a certain temperature, two layers of fluid are formed. The top layer consists of crude sodium naphtholate, which is decanted, whilst the lower stratum is a mixture of caustic soda and sodium sulphite. This lower layer is collected and dissolved in water, and then concentrated, when the sulphite precipitates, settling down to form a layer resembling red sand. The mother-liquid is evaporated further, and is then used over again. The reddish-looking sulphite is recrystallised, when a pure commercial sodium sulphite is obtained.

50. α-NAPHTHYLAMINE SULPHONIC ACID, ETC.—In the manufacture of the azo-reds and scarlets, the naphthols are not always used as such, for if a colour were produced by diazotising an amido compound like naphthylamine, for example, and a naphthol, it would turn out to be an insoluble colour. It is thus necessary, in order to obtain a dyestuff possessing the requisite conditions of solubility, that either or both the above-named materials shall be first sulphonated, naphthylamine- and naphthol-sulphonic acids being respectively obtained. The use of such sulphonated materials means the production of a sulphonated colouring matter, which, again, means a soluble colouring matter, and the degree of solubility being conditioned by the extent of the sulphonation (*i.e.*, the number of sulphonic acid ($-SO_3H$) groups introduced into the molecule of the dye-compound), the manufacturer can, by using sulphonated materials, which are known compounds, regulate and graduate, as it were, the solubility of his dyestuffs in an intelligent manner. It is not found desirable or beneficial to exceed certain tolerably definite bounds in the sulphonating process, and, indeed, various grades of the same dye are obtained according to the degree of sulphonation, these different grades having quite special uses, and hence, frequently, quite special values. These are general rules, and mainly hold good for all the varieties of coal-tar dyes.

Now the methods of converting α-naphthylamine into naphthylamine sulphonic acid were well known many years ago, but this conversion was only effected by means of fuming sulphuric acid. Messrs. LEVINSTEIN & Co. claim to be the first to replace this more expensive agent by the less expensive ordinary sulphuric acid; and since 1881 this firm has manufactured colours from α-naphthylamine-sulphonic acid and β-naphthylamine-sulphonic acid, produced by the aid of common "vitriol." In the specimens No. 83, marked "Roccellin," is a compound produced by bringing together diazonaphthalene-sulphonic acid and an alkaline solution of β-naphthol. The diazonaphthalene-sulphonic acid is obtained by diazotising the α-naphthylamine-sulphonic acid (or naphthionic acid), thus:—

$$C_{10}H_6(\overset{\alpha}{N}H_2)SO_3H + HNO_2 = 2H_2O + C_{10}H_6 \left\langle {}^{SO_3}_{N_2} \right\rangle$$

(Diazonaphthalene-sulphonic acid.)

The reaction by which the colouring matter itself is formed must then be as follows:—

$$C_{10}H_6 \left\langle {}^{SO_3}_{N_2} \right\rangle + C_{10}H_7.\overset{\beta}{O}Na =$$
$$NaSO_3.C_{10}H_6.\overset{\alpha}{N} = NC_{10}H_6.\overset{\beta}{O}H. \text{ ("Rocellin").}$$

The scarlet No. 84, marked A, represents a specimen of the colour produced by bringing together diazonaphthalene-sulphonic acid obtained from the β-naphthylamine-sulphonic acid, and β-naphthol. Instead of sulphonating the naphthylamine or basic compounds, the phenol may be sulphonated, and this idea is realised in Eng. Pat. 623, 1879. The object of this patent is to obtain protection for the manufacture of β-naphtholdisulphonic acids, for their combination with certain aromatic bases, such as xylidine, cumidine, etc., and for the purification and separation of the colours thus obtained. Now, besides combining sulphonated amido-bases with naphthols and amido-bases with sulphonated naphthols, colours may be prepared by the combination of both sulphonated bases and sulphonated naphthols. This firm has discovered a new way of preparing a special mono-sulphonic acid and a tri-sulphonic acid of β-naphthol, and with these such doubly sulphonated azo-colours have been prepared and patented (see

Eng. Pat. 706, 1883.). To form an idea of the comparatively enormous quantities in which the azo-scarlets are used, this firm turns out of its works about four tons per week, and it is further extending its production.

58, 59, 60, 61 AND 62. CALCIUM NITROSO-α-NAPHTHOL SULPHONATE AND NAPHTHOL YELLOW.—This "Naphthol Yellow" is a fine yellow dye for the special mode of manufacturing which Messrs. Levinstein & Co. claim greater simplicity, a better yield and cheaper production. "NAPHTHOL YELLOW" is the alkaline or alkaline-earthy salt of the dinitronaphtholsulphonic acid ($C_{10}H_4(NO_2)_2OH.SO_3H$.). This formula, however, only gives the idea or pattern of one variety of the *naphthol yellow* basis. An interesting preparation exhibited by this firm is the free naphthol-yellow sulphonic acid. This firm also claims new methods of producing nitroso-α-naphthol-mono- and di-sulphonic acids, with the oxidation with nitric acid and conversion into "naphthol yellow" (Eng Pat. 5692, 1882). This dyestuff is said to have almost replaced picric acid; besides being four times cheaper, it is faster, and being an acid colour it is far more useful for compound colours, where acids are used.

63, 64, 65 AND 66. SALTS OF SPECIALLY-PREPARED β-NAPHTHOL - SULPHONIC ACIDS. — Eng. Pat. 706, 1883.

68. SODIUM ANTHRAQUINONE MONO-SULPHONATE.—This firm has found a very simple way of obtaining nearly the theoretical yield of the mono-sulphonic acid, of which the above is the sodium salt. A mixture of molecular weights of fuming sulphuric acid and anthraquinone is heated in closed autoclaves under pressure. (Eng. Pat. 2299, 1883; and also this Journal, ii. [5], 222.)

78. PRINTING SCARLET.—The features of novelty in the preparation of this azo-scarlet are to be found in Eng. Pat. 706, 1883.

79 AND 80. XYLIDINE AND CUMIDINE SCARLETS.—In the preparation of the scarlets the naphthol is sulphonated instead of the amido-compound. (See Eng. Pat. 623, 1879.)

81 AND 82. VERMILLIONS 2B. and xB.—(See Eng. Pat. 706, 1883.)

83. ROCCELLIN.—Special method of production and improved manufacture, as already indicated when referring to 50.

85 AND 86. MALACHITE AND BRILLIANT GREENS.—Prepared from specimens 38 and 39 by the new method of condensation.

87. SYNTHETIC ROSANILINE.—Under this head Messrs. Levinstein claim improvements in the methods of producing the pararosaniline.

88, 89, 90 AND 91. PURPLE I., AND BLUES I., II. AND III.—Blue III. is the well-known "Blackley Blue," the beautiful deep shade, with inclination to violet, of which is well exhibited in the dyed skein of silk encircling the specimen tube. This colouring matter is largely used by paper makers both in Europe and America, as well as by woollen manufacturers. It was discovered in the works of Messrs. Levinstein at Blackley. As regards its chemical composition it is the sodium salt of the disulphonic acid of a diphenylated toluylated rosaniline. Since its introduction into the trade some sixteen years ago, it has largely substituted, not only ultramarine in the tinting of newspaper, but also Prussian blue used for dyeing shop and other packing papers. In conjunction with logwood and bichromate of potassium it is also extensively used for dyeing light and heavy woollen goods, producing fine heavy blue shades comparatively fast, and far cheaper and brighter than the corresponding indigo shades. Messrs. Levinstein state that since its first appearance their firm has produced over 1000 tons, representing a value of nearly one million sterling. "Blackley Blue" has been thought and indeed stated to belong to the indulins, but, as above shown, this is far from being the case.

ANILINE AND OTHER COLOURS AND INTERMEDIATE DERIVATIVES, ETC.,

EXHIBITED BY THE BADISCHE ANILIN- UND SODA-FABRIK OF LUDWIGSHAFEN A/RH. AND STUTTGART (*Group. XIV. No.* 2654).

This company, with works in Ludwigshafen, Stuttgart, Neuville sur Saône and Butirki, near Moscow, and with which the name of Heinrich Caro will be always connected, have brought together in one case specimens of their products and materials. The collection, and especially its arrangement, are striking evidences of artistic skill and scientific research. In these works, under the directorship of H. Caro, assisted by a large staff of chemists and engineers, great results have been achieved.* At the commencement of the catalogue of specimens issued by the Badische Anilin- und Soda-Fabrik, quite a study of itself, we find the following remarks from the pen of Dr. Caro, which form a concise introduction to the collection :—

"Our exhibits at the International Inventions Exhibition are intended to illustrate—both from a manufacturing and scientific point of view—a series of inventions relating to the manufacture of coal-tar products.

"Some of the chemicals—the commercial or scientific names of which will be found in the subjoined list—have been discovered by our chemists, others were the result of scientific research, whilst we have more or less successfully tried to render them commercially available.

"Our claims to the ownership of these inventions are substantiated by due reference to the chemical literature, and to the numbers and dates of our respective patents.

"The exhibits are arranged in nine different groups, the members of which are, as nearly as space would permit, placed in vertical columns. Each group is again subdivided into several inventions."

But the most fitting introduction *to a study*—not a mere inspection—of this beautiful collection would be a previous study of the admirable Address of Dr. Perkin closing the 1884-85 session of the Society of Chemical Industry (see this Journal, iv. [7], pages 427 to 438).

In the following tabulated list I have given the divisions in which the collection is arranged and catalogued with subdivisions; but in tabulating these I have re-arranged them in a more condensed form, so as to furnish what I believe will be a very useful table of reference, serving as an index to the literature, patents, and nomenclature of the dyes. The names of the individual specimens would make a long list, and the most interesting of them have been referred to by Dr. Perkin in his address, *loc. cit.* Hence it would be unnecessary to reprint them all, especially as the literature and patent list are fully given.

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* See President's Address, this Journal, iv. [7], page 437.

TABULATED LIST OF DYES, Etc., DISCOVERED AND MANUFACTURED BY THE BADISCHE ANILIN- UND SODA-FABRIK.

(ARRANGED BY WATSON SMITH.)

Groups of Substances Represented, with other Subdivisions.	Literature.	Patents.	Ex. No.	Special Details of Exhibits, etc.
FIRST GROUP. *Derivatives of Triphenylmethane. Synthesis by means of Benzyl Derivatives.* I.—Acid Magenta, 1877. Sulphonic Acids of the Rosaniline Group.		H. Caro. Eng. Pat. 3731, October 8, 1877. Bad. Anilin- u. Soda Fab. Ger. Pat. 2096, Dec. 16, 1877. H. Caro. U.S. Pats. 204,797, 204,798, and 250,201.		
II.—Benzaldehyde Green (Victoria Green). Manufacture of Benzaldehyde, 1878.	President's Address. This Journ. iv. [7], 430. *Ber.* 1879, p. 796 (lines 3-11).			
III.—Substitution Derivatives of Benzaldehyde and Benzaldehyde Green.	Direct Chlorination of Benzaldehyde. *Ber.* 1884, p. 752.	Trichlorbenzaldehyde Green. Ger. Pat. 25,827. Chlorbenzaldehydes. Dr. Muller. Ger. Pat. 30,329. Paranitrobenzaldehyde condensations. O. Fischer. Ger. Pat. 16,707, 16,766. Paranitrobenzaldehyde from Paranitrocinnamic Acid. A. Baeyer. Ger. Pat. 15,743.	6. 10. 4.	Dichlorbenzaldehyde Green, 1880. Paranitrobenzaldehyde, 1881. Acid Violet, 6B, 1883 (Sulphonated Benzyl-methyl Purple).
IV.—Specimens of Basic Benzyl Derivatives.			17. 19. 20. 21. 23.	Benzyl-diphenylamine. Benzylidene-aniline. Paranitrobenzyl-aniline. Paranitrobenzylidene-aniline. Dibenzyl-aniline.
V.—Specimens illustrating Researches on Constitution of Rosaniline.	This Journ. iv. [7], 431. *Rosolic Acid.* Caro and Wanklyn. *Chem. News.* 1866, vol. xiv. p. 37. —— H. Caro. *Phil Mag.* 1866, 125. —— Caro and Graebe. *Annalen*, 179, 181. —— *Ber.* 1878, 1116. *Dioxybenzophenone.* Caro and Graebe. *Ber.* 1878, 1348. *Triphenylmethane.* E. and O. Fischer. *Annalen*, 194, 242.			
SECOND GROUP. *Synthesis of the Rosaniline series by means of Carbon Oxychloride (Phosgene).* I.—Production of colouring matters by the direct action of Phosgene on tertiary aromatic amines in presence of condensing agents.		Bad. Anilin- u. Soda-Fab. Ger. Pat. 26,016, Aug. 1883; and Ger. Pat. 29,943. Johnson, from H. Caro. Eng. Pats. 4128, Sept. 1883, 11,030, 1884. H. Caro and A. Kern. U.S. Pat. 290,856.	 44. 56. 60.	Crystallised Methyl Purple, 1883. (Hexamethyl-pararosaniline Hydrochloride). *Products resulting from the direct action of Phosgene on Tertiary Amines.* Diethylpara-amidobenzoate Para-amido of Sodium. Dimethylamido-alpha-naphthoic Acid. Hexa-methyl-triamido-dibenzoyl-benzene.
II.—Production of Leucobases of the Rosaniline series, by condensation of Hydrol-bases with aromatic amines.		Bad. Anilin- u. Soda-Fab. Ger. Pat. 27,032, Oct. 1883. Johnson, from A. Kern. Eng. Pat. 5450. Nov. 1883. A. Kern. U.S. Pats. 290,891, 290,892, and 290,893.	39.	Hexamethyl-pararosaniline Sulphate, 1883.
III.—Production of colouring matters by the condensation of halogen derivatives of Tetramethyldiamidobenzophenone and analogous Ketone bases with secondary and tertiary aromatic amines, 1883.	President's Address. This Journ. iv. [7], 432.	Bad. Anilin- u. Soda-Fab. Ger. Pats. 27,789, and 29,962. Johnson, from H. Caro. Eng. Pats. 4850, 5038, 11,159, 1884. A. Kern. U.S. Pats. 297,413, 297,414, 297,415. A. Kern and H. Caro. U.S. Pat. 297,416.	31. 35.	Victoria Blue B, 1884 (Condensation-product of tetramethyldiamido-benzophenone with alpha-Phenylnaphthylamine). Victoria Blue, 4R (Condensation-product of Tetramethyldiamido-benzophenone with Methylphenyl-alpha-naphthylamine, etc., etc.).

Groups of Substances Represented, with other Subdivisions.	Literature.	Patents.	Ex. No.	Special Details of Exhibits, etc.
IV.—Auramines—Condensation products of Ketone bases with Ammonia and primary aromatic amines. 1883.	President's Address. This Journ. iv. [7], 432.	Bad. Anilin- u. Soda-Fab. Ger. Pat. 29,060, March, 1884. Johnson, from H. Caro. Eng. Pats. 5512, 5741 (1884). H. Caro and A. Kern. U.S. Pat. 301,802.	34. 35.	Auramine. Commercial product, 1884. Tetramethyldiamido-benzophenone.
THIRD GROUP. *Phthaleins.* I.—Eosine, 1874.—Manufacture of Resorcinol and Phthalic Anhydride.	A. Baeyer. *Ber.* 1875, 116. A. Baeyer. *Annalen*, 1876, **183**, 38. This Journ. iv. [7], 431.			
II.—Cœrulein S.	This Journ. iv. [7], 431. Baeyer. *Ber.* for 1871. Schultz. *Chemie des Steinkohlentheers.* 1002, 1003.		68. 67.	Cœrulein. Commercial in 1878. Cœrulein S, 1881 (Cœrulein Sodium Bisulphite Compound).
III.—Specimens illustrating Researches on Phthaleins, and their conversion into Anthraceae Derivatives.	A. Baeyer. *Annalen*, **183**, 1; **202**, 36. Baeyer and Caro. *Ber.* for 1874, 969; *Ber.* for 1875, 152.		80. 76. 116. 118. 119.	Phthalophenone (Diphenylphthalein). Phenolphthaleïn (Dioxydiphenylphthalide). Phenolphthalidein (Dioxyphenyl-oxanthranol), Group IV. Erythro-oxyanthraquinone. (From Phenolphthalein), Group IV. Quinizarine. (From Parachlorophenol), Group IV.
FOURTH GROUP. *Anthracene, Phenanthrene, Carbazol, Acridine, and their Derivatives.* Manufacture of Artificial Alizarin. I.—Graebe and Liebermann's Original Process, 1868.	This Journ. iv. 7, 131, 432, 433. This Journ. ii. 213 to 227 Graebe and Liebermann. *Ber.* for 1868, 19, 101; *Ber.* for 1869, 14; *Annalen*, Suppl. 7, 257, and vol. **160**, 121; *Monit. Scient.* 1879. Dr. Perkin. *Journ. Chem. Soc.* 1880, 554.	Graebe and Liebermann. Eng. Pat. 3850, Dec. 18, 1868. Graebe and Liebermann. U.S. Pat. 95,465.		
II.—Caro, Graebe and Liebermann's Process, 1869.	Caro, Graebe and Liebermann. *Ber.* for 1870, 359. Graebe and Liebermann. *Annalen*, **160**, 130; *Monit. Scient.* 1879. Schunck and Roemer. *Ber.* 1876, 681. Perkin. *Journ. Soc. Arts*, May 30, 1879.	Caro, Graebe and Liebermann. Eng. Pat. 1936, June 25, 1869. U.S. Pat. 153,536.		
III.—Alizarin-Orange, 1876.	*Ber.* for 1877, 1760. *Ber.* for 1879, 1008. *Monit. Scient.* 1879, 424 (Graebe and Liebermann). *Annalen*, 1880, **201**, 353. President's Address. This Journ. iv. [7], 433.	Johnson, from H. Caro. Eng. Pat. 1229, March 22, 1876. H. Caro. U.S. Pat. 186,032, January 9, 1877.		
IV.—Alizarin-Blue, 1878.	President's Address. This Journ. iv. 433. C. Graebe. *Ber.* 1879, 1116. H. Brunck, Graebe. *Ber.* 1878, 522 and 1646. C. Graebe. *Annalen*, 1880, **201**, 333. H. Brunck and C. Graebe. *Ber.* 1882, 1783.	Bad. Anilin- u. Soda-Fab. Ger. Pat. 17,695, August 11, 1881. Johnson (from B.A.S.F.). Eng. Pat. 3603, August 18, 1881. H. Brunck. U.S. Pats. 258,530, 258,531, and 271,081.	87.	Alizarin Blue S. Commercial Product, 1881.
V.—Specimens illustrating researches on constituents of crude Anthracene.	*Phenanthrene.* Graebe and Glaser, *Ber.* 1872, 861 and 968. *Diphenylene-glycollic Acid.* (H. Caro), Friedlaender, *Ber.* 1877, 126 and 534. *Carbazol.* Graebe and Glaser, *Annalen*, **163**, 343. *Phenylnaphthylcarbazol.* (Brunck) Graebe, *Ber.* 1879. *Acridine.* Graebe and Caro, *Annalen*, **158**, 265; *Ber.* 1880, 99. *Chrysaniline.* O. Fischer and Koerner, *Ber.* 1884, 203. *Phenylacridine.* A. Bernthsen. *Ber.* 1883, 1809.		100. 104. 105. 114. 115. 101. 120. 109. 103. 139. 146. 133.	Phenanthrene. Phenanthrenequinone. Diphenylene-glycollic Acid. Diphenylene-ketone. Diphenic Acid. Carbazol. Nitroso-carbazol. Phenylnaphthylcarbazol. Acridine Hydrochloride. Phenyl-acridine (Group V.). Diamido-phenyl-acridine (Chrysaniline). Chrysaniline Nitrate.

Groups of Substances Represented, with other Subdivisions.	Literature.	Patents.	Ex. No.	Special Details of Exhibits, etc.
FIFTH GROUP. *Quinoline.* I.—Skraup's Synthesis of Quinoline and its Derivatives, 1881.	*Artificial Quinoline.* Skraup. *Monatsh. Chem.* February, 1881. *Oxyquinolines.* Skraup. *Ber.* 1882, 893. *Anisidines.* Brunck. *Zeits. fur Chem.* 1867, 205.	Bad. Anilin- u. Soda-Fab. (Skraup). Ger. Pats. 14,976, February 16, 1881; 28,324, November, 1883; 30,426, June, 1884. Eng. Pat. 678, February 16. 1881. Skraup. U.S. Pats. 237,917, 237,918, 241,738, 295,825, and 308,286.	129. 131. 137.	Artificial Quinoline Tartrate. Thalline Sulphate (Paramethoxyhydroquinoline Sulphate). Thalline (Base).
II.—Derivatives of Quinoline allied to the Rosaniline, artificial Alizarin and Indigo groups.			138. 87. 143. 139. 144. 149.	Quinoline Green. Second Group, III. Alizarin Blue S. and Salts. Fourth Group, IV. Anthraquinoline. Fourth Group, IV. Group Four. V. (see above). Monochlorquinoline. Sixth Group, IV. Oxycarbostyril.
SIXTH GROUP. *Artificial Indigo.* I.—Cinnamic Acid, 1880.		Bad. Anilin- u. Soda-Fab. Ger. Pat. 17,467, Aug. 1880. Johnson, from H. Caro. Eng. Pat. 3330, Aug. 17, 1880.	148. 149.	Benzylidene Dichloride. Cinnamic Acid.
II.—Synthesis of Artificial Indigo from Derivatives of *O*-nitrocinnamic Acid, 1880.	Dr. Perkin. This Journ. iv. [7], 435. Letter from Baeyer to Roscoe. This Journ. 1882. 17. A. Baeyer. *Ber.* 1880, 2254.	Ger. Pat. 11,858, March, 1880. Johnson, from Baeyer. Eng. Pats. 1177 and 1771, March 18, 1880; and 466. Feb. 1881. A. Baeyer. U.S. Pats. 228,300, 233,460, and 233,458. Baeyer and Caro. (Printing with Sodium Xanthate.) U.S. Pat. 240,360.		
III.—Synthesis of Artificial Indigo by condensation of *O*-nitrobenzaldehyde and its Derivatives with Acetone, 1882.	A. Baeyer and Drewson. *Ber.* 1882, 2856.	Bad. Anilin- u. Soda-Fab. Ger. Pat. 19,768, Feb. 21, 1882. Johnson, from the B.A.S.F. Eng. Pat. 1266. March 16, 1882. Baeyer and Drewson. U.S. Pats. 257,813, 257,814, and 257,815. *Chlorindigo*, B.A.S.F. Ger. Pat. 32,238, March 28, 1881. *Chlorobenzaldehyde.* H. Müller. Ger. Pat. 30,329, June, 1883.	150. 152. 162. 11. 159. 156.	*O*-nitrobenzylchloride. *O*-nitrobenzaldehyde. *M*-methyl Indigo. (From *O*-nitro-*m*-xylylaldehyde.) Dichlorbenzaldehyde, Group I. *O*-nitrodichlorbenzaldehyde. Tetrachlor-indigo.
IV.—Specimens illustrating Researches on Artificial Indigo.	A. Baeyer. *Ber.* 1880, 2254; 1881, 1741; 1882, 775. Friedlaender. *Ber.* 1882, 332.			
SEVENTH GROUP. *Methylene Blue*, 1877. I.—Production of Methylene Blue from Nitroso-, Nitro-, Azoxy-, Azo-, and Amido Derivatives of Dimethylaniline.	*Nitrosodimethylaniline.* Baeyer and Caro. *Ber.* 1874, 809 and 963. *Methylene Blue.* Bernthsen, *Ber.* 1883, 1025.	H. Caro. Eng. Pat. 3751, Oct. 9, 1877. B.A.S.F. Ger. Pat. 1886, Dec. 15, 1877. H. Caro. U.S. Pat. 204,796.		
II.—Synthesis of Lauth's Violet, 1883.	Bernthsen. *Ber.* 1883, 1025 and 2896; also 1884, 611, 2854, 2857, 2860.	B.A.S.F. (Bernthsen). Ger. Pat. 25,150, May, 1883. Bernthsen. U.S. Pats. 286,526 and 286,527.	172. 176. 177. 180.	Thiodiphenylamine. Alpha-Dinitro Derivative of Thiodiphenylamine. Lauth's Violet. (Amidoimido Derivative of Thiodiphenylimide.) Methyl-thiodiphenylamine.
EIGHTH GROUP. *Azobenzene and its Derivatives.* I.—Palatine Orange, 1869. Manufacture of Azobenzene and Benzidene.	Schultz. *Chem. des Steinkohlentheers*, p. 779. Fehling's *N. Handworterb*, vol. iii. 791.		182.	Palatine Orange (Commercial Product). Ammonium Salt of Tetranitro-γ-diphenol.

Groups of Substances Represented, with other Subdivisions.	Literature.	Patents.	Ex. No.	Special Details of Exhibits, etc.
II.—Amido Derivatives of Azobenzene. Fast yellow.	*Chrysoidine. Ber.* 1877, 388.		186. 187. 192.	Fast Yellow (Sodium Amidoazobenzene Sulphonate), 1878. Helianthin (Sodium Dimethylamidoazobenzene Sulphonate), 1877. Chrysoïdine (Diamidoazobenzene Hydrochloride), 1875.
III.—Indulins. By-products of the Indulin-process.	Fehling's *N. Handwörterb*, vol. iii. 791 ("Induline").		183. 184. 191. 194. 195.	Indulin from Azobenzene. (Commercial Product.) Sodium Indulin Sulphonate. (Commercial Product.) *By-Products of the Indulin Process.* Azophenin. Fluorindin. Calcium Fluorindin Sulphonate.
IV.—Safranins.	Schultz. *Chem. des Steinkohlentheers*, 1019. *Ber.* 1883, 466.		188. 189. 185.	Paranitraniline. Paraphenylenediamine Hydrochloride. Phenosafranin.
NINTH GROUP. *Naphthol Derivatives.* I.—Naphthol Yellow S., 1879.	Lauterbach. *Ber.* 1881, 2028. Graebe. *Ber.* 1885, 1126.	B.A.S.F. Ger. Pat. 10,785, Dec. 28, 1879. Johnson from H. Caro. Eng. Pat. 5305, Dec. 29, 1879. H. Caro. U.S. Pat. 225,108.	212. 199. 198. 197. 200.	Alphanaphthol. Alphanaphthol - potassium Trisulphonate. Dinitro-alpha-naphthol monosulphonic Acid. Naphthol Yellow S. (Potassium Salt of Dinitro-alpha-naphthol Sulphonic Acid). *Commercial Product.* Di - imido - alpha - naphthol Monosulphonic Acid.
II.—Conversion of Naphthols into Naphthylamines by the action of ammonia and amines. Manufacture of Beta-Naphthylamine, 1879.	*Phenylnaphthylamines. Phenylnaphthylcarbazol. Ber.* 1879, 2242. Graebe. *Ber.* 1880, 1849.	B.A.S.F. (H. Caro). Ger. Pat. 14,612, Feb. 1880. B.A.S.F. (C. Glaser). Ger. Pat. 20,760, Nov. 1881.		
III. — Azo-colours produced by combination of Beta-Naphthol and its sulphonic acids with the diazo - compounds of amido-azobenzene and its homologues.	*Azo-colours from the Diazo Compound of Amidoazobenzene.* H. Caro and C. Schraube. *Ber.* 1877, 2230; and 1880, 803.	F. Koehler. U.S. Pats. 224,927 and 224,928. Schuncke. U.S. Pat. 216,221.	207. 208.	Fast Scarlet (Combination of Diazo azo-benzene Sulphonic Acid with beta-Naphthol), 1878. Archil Red (Combination of Diazo-azo-xylene with beta-naphthol Disulphonic Acid), 1880.
IV. — Azo - colours produced by combination of Beta-Naphthol and its sulphonic acids with the diazo-compounds of *O*-anisidine, its sulphonic acids and homologues, 1878.		B.A.S.F. Ger. Pat. 12,451, Jan. 1879. J. P. Griess. Eng. Pat. 4726, Nov. 20, 1878. J. P. Griess. U.S. Pats. 213,563 and 213,564.	226. 218. 206. 219. 222. 209.	*O*-nitranisol Calcium Sulphonate. *O*-anisidine Calcium Sulphonate. Anisol Red (from *O*-anisidine and beta-Naphthol monosulphonic Acid). Anisol Red (from No. 218, above, and beta-Naphthol monosulphonic Acid). Ethyl *O*-amido-cresylate. Cresol Red (from 222 and beta - Naphthol - disulphonic Acid).
V.—Azo-colours by combining Naphthols and their sulphonic acids with the diazo-compounds of Alpha - Naphthylamine and its sulphonic acids (Oxy-azonaphthalene sulphonic acids, 1877).	J. P. Griess. *Ber.* 1878, 2199 ("Fast Red.")	B.A.S.F. Ger. Pat. 5411, March 12, 1878. Johnson, from H. Caro. Eng. Pat. 786, Feb. 25, 1878. H. Caro. U.S. Pat. 204,799.	211. 223. 215. 230. 224. 213. 214.	alpha-Naphthylamine. Calcium Naphthionate. Fast Brown (from No. 223 and alpha-Naphthol). Fast Red (from No. 223 and beta-Naphthol). Fast Red (from Clève's beta-Nitronaphthalene sulphonic Acid and beta-Naphthol). Fast Red C. (from 211 and alpha-Naphthol monosulphonic Acid). Fast Red D. (from 223 and beta-Naphthol Disulphonic Acid).

(To be Continued.)

Journal and Patent Literature.

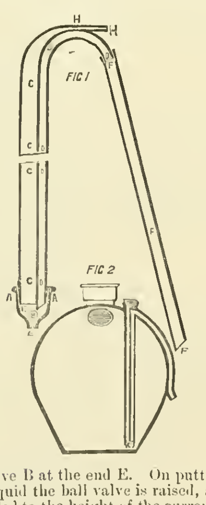
I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

On the Construction of Chimneys. L. Ramdohr. Chem. Zeit. **9**, 903.

THE author recommends the construction of chimneys with equal inside width from the base to the top. There are two ways of building such chimneys—viz. (1) dressing the bricks in nearly every course of the brickwork, which plan involves a great deal of troublesome work and waste of material, and is therefore not advisable; or (2) building the chimney in several steps, and giving the top end of each step the normal width intended. The height of these steps should not exceed 5·5 metres. As regards the calculation for the inside width of the chimney, it is essential that its narrowest section be nearly equal to the sum of the air spaces left between the fire-bars. This width must even be increased for low chimneys, whereas it may be a little diminished for high ones. For small boilers or furnaces, the chimney need not be higher than 16m.; for large furnaces a height of 35m. is sufficient, if the chimney be not far from the fire; but if the distance be considerable the height must be increased to 50—60m., whereas the width may be diminished to from $\frac{2}{3}$ to $\frac{1}{2}$ of the calculated width. The flues leading to the chimney should at least be as wide as the sum of the air spaces between the bars. For the base well-burnt bricks are better than quarry stones. The cap has an inclination of 30° to the outside. The thickness of the brick-work at the top should in no case be less than 20cm.—S. H.

A New Syphon. Chem. Zeit. **9**, 907.

BODE and Wimpf have designed a new kind of syphon, which is of great use for syphoning off acid, caustic or poisonous liquids. Its special feature is due to the fact that it is not set by suction, but by blowing so that the liquid to be syphoned off can never get into the mouth. Fig. 1 represents the construction. The tube D is surrounded by a wider one C, closed at the top, and provided



with a ball valve B at the end E. On putting the apparatus into a liquid the ball valve is raised, and the tubes C and D are filled to the height of the surrounding liquor. If now air be blown into the tube H, the valve is closed, and the liquid being driven from C into D and F sets the syphon to work. The blowing is then discontinued and H closed. If it be desired to interrupt the flow, it is only necessary to blow again a little stronger through H. The valve B is now pressed into its seat, and no liquor being able to enter the syphon, it empties itself. The syphon need never be removed from the liquid, either at the start or at the end. C. Gerhard, of Bonn, and the Möncheberg Pottery, are prepared to supply the syphon to the trade. It can be made of glass, earthenware, ebonite, indiarubber, and metal. It is also intended to fit Woulff's bottles with this syphoning arrangement, as shown in Fig. 2, for drawing off acids in the course of the manufacture.—S. H.

Improved Anti-incrustation Composition for Steam Boilers. A. M. Clark. From Van Baerle & Co. Eng. Pat. 11,518, August 21, 1884.

THE composition consists of silicate of soda or potash, with or without the addition of alkali in any form.

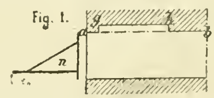
—H. J.

II.—FUEL, GAS, AND LIGHT.

Improvements in Coke-Ovens. Dingl. Polyt. J. **256**, 359.

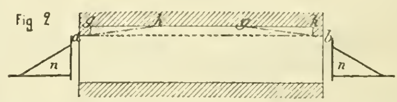
SACHSE (Ger. Pat. Add. 30,021, June 18, 1884) now gives his horizontal coke-oven a rectangular cross section

Fig. 1.



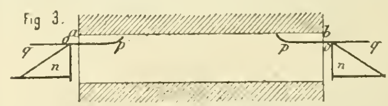
throughout, the walls are perpendicular, and the top is not built vaulted, but consists of plates of iron lined with refractory clay laid upon the upright walls. Spaces

Fig 2



between the walls and plates, or between contiguous plates, are luted with clay. The advantages of this new system are, that immediately after the introduction of

Fig 3.



the charge it can be stamped down, and also that any part of the oven may be made accessible from above, either during work or rest.

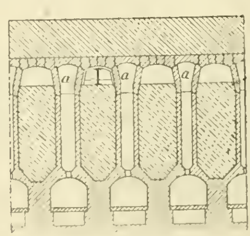


Fig 4.

The arrangement adopted by Lürmann (Ger. Pat. 29,557, June 14, 1884, Add. to 18,693) for compressing coal in coking it in horizontal ovens, is illustrated in

Figs. 1, 2, and 3. As shown in Figs. 1 and 2, the roof is made somewhat higher in part to allow free passage for the gases evolved. The compression is obtained by means of *nn*. The arrangement shown in Fig. 3 is may be either fixed or movable. In the latter case the size of the gas passage is regulated by the distance to which *op* is inserted.

To increase the yield of by-products from the distilla-

Fig 5.

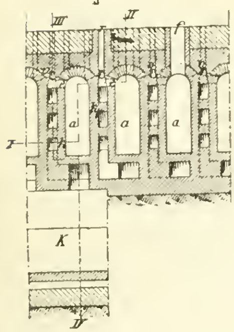


Fig. 6.

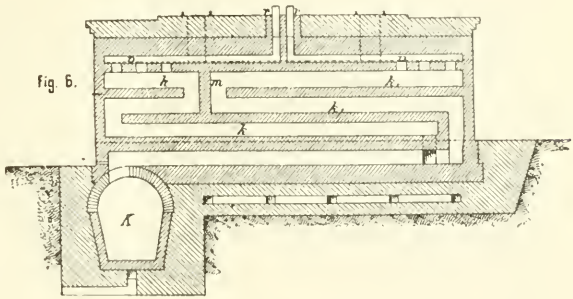


Fig. 7.

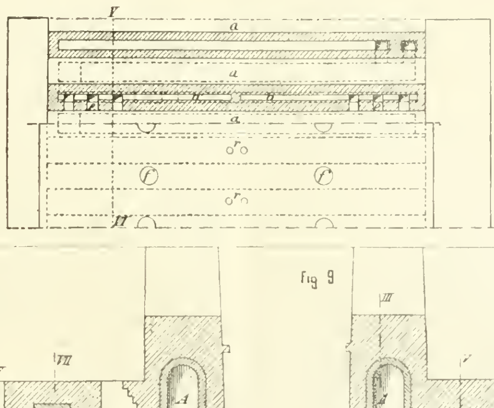


Fig 8.

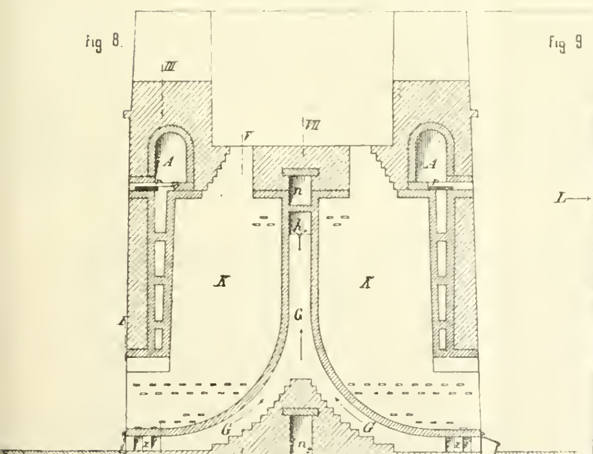
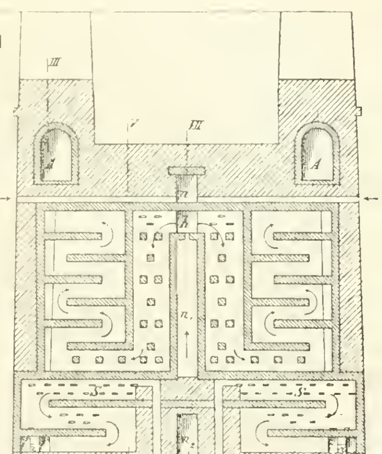


Fig 9.

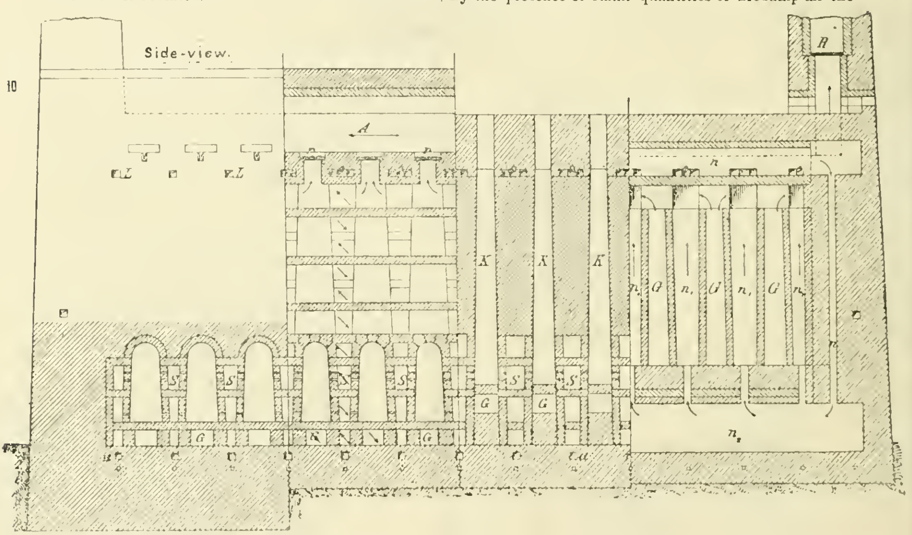


adopted when it is desirable not to make any alteration in the roof. A passage for the gases is maintained or obtained by means of the iron arrangement *op*, which tion gases of coke-ovens, Brunck covers the material under treatment with a layer of small coke, lime, or the like, and also makes an addition of lime to the charge to

increase the yield of ammonia (Ger. Pat. Add. 29,018, Dec. 21, 1883). The arrangement of the oven is shown in Fig. 4.

In order to increase the durability of coke-ovens with horizontal gas canals, Brzezowski (Ger. Pat. 29,228, March 12, 1884) collects the gases at two different points in the upper part of the chamber, and by thus dividing the stream of gas is enabled to reduce the sectional area of the gas passages. Figs. 5 and 6 are sectional views, Fig. 7 is the plan of the arrangement and construction. The distillation gases pass from the chambers a through horizontal channels c at each end of the upper part of the chambers, into the channels k, k, disposed horizontally one above the other. Above the gas channels are air passages v, connected with the outer air by the tubes r. Air is supplied by means of r v into the gas passages k and k_1, the draught caused by the chimney in connection with the main gas canal k being quite sufficient to produce the in-current of air. The distillation gases are thus inflamed as soon as they pass from a. By the partition wall m being built from above, and not extending the whole depth of the gas passages, the necessity for a double main is obviated.

Fig 10



In Bauer's upright coke-oven, illustrated by Figs. 8, 9, 10 (Ger. Pat. 28,530, February 26, 1884), the distillation products proceeding from the coking chamber K proceed through a double series of slits near the bottom of the chamber into the passage S, and there meet air which enters at a, and is warmed before mixing with the distillation gases in S. The mixed air and gas in a state of combustion is drawn from the lower part of S through the channel z into the passage G beneath the hearth of the chamber, proceeds through the vertical portion of G upwards, and at the top, just beneath the cover of the chamber, mixes with air introduced in regulated amount at L, and heated by passing through the horizontal passage n, downwards into n_2, and thence into the upright passages n situate between the gas passages G mentioned above. At the top of n_1 are slits through which the hot air passes into k, there to meet the stream of burning gases from G. Near this point a small number of slits in the wall of K allow a further amount of the distillation gas to mix with the gases from G, and the hot air from e; the direction now taken by the current is shown by the arrows. The draught is regulated by registers r at the entry into the outlet A, and further by the chimney register R. The gases may be collected to be worked for tar and ammonia, either just beneath the cover of the chamber or near the fire door at the lowest part of the hearth.—W. D. B.

Report of Experiments in the König Coal Mine, on the action of Shot-firing on Coal-dust and Firedamp. Chem. Zeit. 9, 641.

THE experiments have, so far, had the following practical results :—(1.) In the presence of coal-dust, which occurs in mines in the neighbourhood of the concussion, the normal flame length of a shot is always more or less extended. (2) a. In the complete absence of firedamp the length of the flame is a limited one, and does not exceed, however far the dust extends, 6 to 15 metres, for most kinds of dust, provided that clay is used, and the walls of the bore do not give off gas with the explosion; 9 to 21 metres, if coal-dust is used as covering, or the walls of the bore, with the action of the blast, give off dust and gas. b. There are also certain kinds of coal-dust which are ignited by shot-firing, and when once ignited burn on and give not only flame of great length, but also the phenomena of an explosion, when no firedamp is actually present. (3) a. By the presence of small quantities of firedamp all the effects of combustion are intensified; nevertheless those kinds of coal-dust which alone give flames of a limited length, produce with firedamp up to 3 per cent. only a moderate lengthening of the flame, but not by any means an expansion throughout the length of the dust present. b. If, however, the percentage of firedamp is 4 per cent. or more, these kinds of dust give an unlimited transfer of flame, which otherwise would not be the case. c. Those kinds of dust, which of themselves conduct the flame unlimitedly, give with less than 3 per cent. of gas, real explosions. (4.) By means of coal-dust isolated regions containing firedamp even at great distances may become connected with the scene of the shot-firing, and will produce an explosion, even though no fire-damp has been originally present at that spot.—J. B. C.

The Gaseous Products of the Combustion of Coal. A. Scheurer-Kestner. Bull. Mulhouse, 1885, 328.

THIS is a reply to the criticisms of F. Fischer contained in a recent article (*Polyt. J.* 251, 323). The author reasserts the statements made by him in 1868, in regard to the trustworthiness of analyses of these products after having been collected over water, as representing the actual result of the combustion of the coal.

In regard to the influence of the supply of air upon the combustion, the author corrects certain misrepresentations, by restating his former conclusions, that to obtain the maximum effect from a coal, about one-third of the air supplied should remain unused.—C. F. C.

On the Reduction of Carbon Dioxide to Carbon Monoxide, by means of Carbon. A. Naumann and C. Pistor. Ber. **18**, 1647-1657.

WATER-GAS, which is formed by passing steam over incandescent coal, does not only contain carbon monoxide and hydrogen, but also carbon dioxide, often in very considerable quantities. The reaction expressed by the equation, $H_2O + C = CO + H_2$ is, in fact, only a desirable maximum which can never be fully attained. The authors attempted to find out how far the completeness of the reaction depends on the temperature. For this purpose a combustion-tube filled with purified charcoal was heated in a combustion furnace while dry and pure carbon dioxide was passing through it. For measuring the temperature a number of small glass tubes filled with salts or metal wires of known fusing point was uniformly divided amongst the charcoal in the combustion-tube, and according as one salt was fused at the end of an operation and another was not fused, the temperature was considered to lie between these limits. The analysis of the gas which escaped at the end of the tube was performed according to Bunsen's method. The results of the experiments will be seen from the following table:—

Obtaining Sulphur from Furnace Gases. Emil Hänisch and Max Schroeder, Neumühl-Hamborn, Prussia. Eng. Pat. 6404, May 26, 1885.

THE sulphur dioxide, after separation from the accompanying gases, by absorption in a water-tower with subsequent boiling of the aqueous solution, is led first through a vertical cylinder containing carbonaceous material, heated externally by producer gas, whence a mixture of sulphur vapour and unchanged sulphur dioxide with the oxides, sulphide, and oxy-sulphide of carbon is obtained. This mixture is then passed through an externally heated cylinder, filled loosely with fire-brick; here a mutual reaction occurs resulting in sulphur (in the gaseous state) and carbon dioxide—

$$SO_2 + C = S + CO_2.$$

Carbon monoxide may be substituted for carbon—

$$SO_2 + 2CO = S + 2CO_2.$$

To effect the reaction with this gas half of the carbon dioxide produced in the reaction is returned and passed through the first cylinder, where it becomes converted into the mon-oxide, afterwards meeting with the sulphur dioxide which, in this case, is introduced into the channel between the two cylinders, the reaction taking place solely in the second of these. The sulphur vapour is condensed and collected in suitable chambers. —W. G. M.

On Explosions caused by Dust. C. Engler. Chem. Ind. **8**, 171.

OWING to repeated explosions in the lamp-black works of the Black Forest, the author investigated the causes of

No. of Experiment.	Length of layer of Charcoal.	Temperature.	Inside diameter of Combustion-tube.	Number of gas-bubbles per second.	Percentage of CO in the gas after passing incandescent coal.
1	66cm.	Less than 501° C.	15mm.	From 2 to 3	None
2	66cm.	Between 530° and 585° C.	15mm.	,, 2 to 3	Trace
3	66cm.	,, 530° and 602° C.	15mm.	,, 2 to 3	12·6%
4	10cm.	602° C.	15mm.	,, 2 to 3	None
5	10cm.	Between 634° and 703° C.	15mm.	,, 2 to 3	Trace
6	30cm.	Less than 811° C.	8mm.	{ 1·0 90cc. in 16min.	12·7%
7	21cm.	Between 861° and 954° C.	8mm.	{ 1·7 100cc. in 10min.	58·3
8	10cm.	,, 954° and 1054° C.	8mm.	{ 1·2 135cc. in 18min.	94·2
9	57cm.	,, 861° and 951° C.	8mm.	{ 3·0 150cc. in 8min.	90·7
10	2cm.	,, 1035° and 1100° C.	8mm.	{ 3·0 70cc. in 4min.	18·1
11	{ 4cm. C + 8cm. Cu + 4cm. C + 8cm. Cu + 2cm. C. }	,, 861° and 951° C.	8mm.	{ 2·0 100cc. in 8min.	36·5

—S. H.

Heat of Combustion of Ronchamp Coal. A. Scheurer-Kestner. Bull. Mulhouse, 1885, 333.

THE author's previous results on this subject have been criticised by Bunte and Stohmann. With the view to end the controversy on the point at issue between them, the author appeals to recent numerical results which entirely confirm the preceding. The mean composition of the coal, ash free, and dried at 110° was: C, 89·09; H, 5·09; N, 1·30; O, 4·52 per cent., the heat of combustion for 1grm. 9130cal. Calculating from the composition of the coal—the calculation including a deduction for the hydrogen burnt at the expense of the oxygen of the coal, according to Dulong—the number of calories is 8761, the difference being 369, or 4·25 per cent. The author upholds therefore the statements on this subject made by himself and his collaborateur, Meunier-Dollfus, in 1868-1870.—C. F. C.

such accidents. These may be produced by igniting a mixture of (1) combustible gases with air; (2) fine particles of coal or soot with air; and (3) combustible gases and soot with air. The conditions under which combustible gases explode with air have been clearly defined by Bunsen, Winkler, and Wagner. On the second point the author found that a thick cloud of common coal soot produced in an apparatus devised for that purpose can neither be ignited by a "naked" light nor by the induction spark of a powerful Ruhmkorff. Clouds of flour, sulphur, naphthalene, or colophonium ignite at once very vigorously, especially the last with explosive force. Soot being in a hot state in the soot-chambers, a cloud of soot and charcoal, 300° C. hot, was produced in the apparatus, but on introducing a light no transmission of the flame could be observed. It therefore appears that explosive effects are only produced by those substances which on heating give off combustible gases.

Hilt arrived at the same conclusion when investigating explosions in coal-pits caused by coal-dust. A series of experiments was also made on the nature of air mixed with coal or soot particles and combustible gases.

	Vols. per cent. illuminating gas and coal-dust.	
Air, containing	12·3	ignites with violent explosion
" "	10·2	" " "
" "	9	" " "
" "	8	" " "
" "	7	ignites quickly without explosive force
" "	5·6	" " "
" "	3·5	" " "
" "	2·4	does not ignite

Further experiments showed that air containing 7·5 per cent. illuminating gas and no coal-dust cannot be ignited under the same conditions, and it is therefore evident that a gas mixture, which is harmless by itself, burns with an explosive force when mixed with coal-dust. The same experiments made with marsh gas gave an equal result.—S. H.

Improvements in the Treatment of Gas and in the Materials and Apparatus employed therein. F. Leslie and J. A. Wanklyn, London.

THIS invention relates to the carrying out of a process described by the above patentees in their Provisional Specification 419, January 12, 1885, which consists in separating gas into two qualities for heating and lighting. This process depends upon the fact that the former is lighter and passes more readily through a partition of porous material. It is now stated that this separation can be much more easily effected in the presence of an oily or fatty substance. The apparatus consists of a cylinder with closed ends, having a division of wire gauze, upon which rests the porous material employed. Below the gauze two pipes enter the cylinder; one admits coal gas in its ordinary condition, and the other allows the heavy illuminating gas to pass away. Above the gauze is another exit pipe to carry off the light heating gas which has made its way through the porous material. For this last, linseed meal is recommended, but any crushed oily seed will answer, as will also fragments of stearic acid, tallow, pieces of cork, bark, or such like, coated with oil or lard.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

A New Lutidine. A. Ladenburg and C. F. Roth. Ber. **18**, 1590

FROM that fraction of bases obtained from Dippel's oil boiling at 174—176°, a third lutidine has been obtained by precipitation with $PtCl_4$. The platinum double salt forms a voluminous precipitate of a dark orange colour, which easily decomposes. On recrystallisation it is obtained in needles or pointed plates of a characteristic bronze colour. The hydrochloride of the base is obtained from the platinum salt by means of H_2S, and with potash the free base is separated. It is an oil distillable with steam and possessing the penetrating smell of lutidine (B. P. 174—176°).—J. B. C.

The Decomposition of the Terpenes by Heat. Berthelot. Ann. Chim. Phys. (6), **5**, 136.

TILDEN'S experiments confirm the views long held by the author—viz., that the terpenes do not belong to the aromatic series, but are formed by polymerisation of the double amylene, C_5H_8.—J. B. C.

Valuation of Ozokerite. Lach. Chem. Zeit. **9**, 905.

ONE HUNDRED grms. ozokerite are treated with 20grms. fuming sulphuric acid in a tared basin. The mixture is heated from 170 to 180°, and continuously stirred until all sulphur dioxide has escaped. On reweighing the difference presents the yield of volatile products—viz., petroleum and water. Another quantity of ozokerite is mixed with 10 per cent. of decolourising powder (residues from the manufacture of prussiates), previously dried at 140° C. A tenth part of the mixture is weighed off and put into a small cylindrical filter, closed at the bottom, whose weight is known, when dried at 130° C. The contents are then extracted with benzene in a small extracting apparatus. The filter is dried at 130° C., and reweighed, and from the loss the percentage of wax can be calculated. By evaporating the benzene solution and drying the residue at 180° C., this result may be verified, while the melting point of the wax can also be ascertained.—S. H.

Improvements in Separating Solid Paraffin from Oils. G. T. Beilby, Midcalder. Eng. Pat. 11,987, September 4, 1884.

THIS invention relates to apparatus for cooling and crystallising paraffin oils in a state of repose, and has reference also to the breaking up of the solidified mass, and feeding the same to the apparatus used for separating the solid portions of the paraffin from the liquid portions. The apparatus consists of a narrow vertical cell whose outer walls are exposed to the cooling influence of the air; in the lower part a rotating screw is arranged horizontally and longitudinally, which by its action breaks up the solidified mass in the cell and discharges it continuously into pipes leading to a filter-press.—D. B.

An Improved Process and Apparatus for Extracting Benzene from the Gases evolved in Sealed or Closed Coke-Ovens. John Coates, London. Eng. Pat. 11,202, May 1, 1885.

AFTER passing through the ammonia scrubbers the gases are drawn through one or more rectangular washers, made perfectly gas-tight, and containing tubes or plates so disposed as to cause the gas to pass through the washing liquid, which is preferably an oil having an affinity for benzene. From the washers the gas passes up a scrubber consisting of a tower packed with boards, coke, tiles, or other suitable material down which the absorbing oil is allowed to trickle. The oil is drawn off and the benzene distilled from it by any known process. —A. R. D.

IV.—COLOURING MATTERS AND DYES.

Dioxypyrenequinone. H. Reinherz, Ger. Pat. 31,091, July 16, 1884; and Dingl. Polyt. J. **256**, 323.

AFTER heating one part pyrenequinone with 4—5 parts concentrated sulphuric acid at a temperature of 180—210° for 2—3 hours, the disulphonic acid is obtained. On purifying somewhat with calcium or lead salts, and heating with potassium or sodium lye, or fusing with solid caustic alkali, the potassium or sodium salt respectively of dioxypyrenequinone is obtained, the red coloured aqueous solution of which gives coloured precipitates with lead acetate and metallic chlorides. Hydrochloric acid precipitates the dioxy-compound as a reddish-brown powder, which can be purified by recrystallising from alcohol. The alkaline salts of the bisulphonic acid are almost colourless, and are somewhat difficultly soluble in water; the solutions, however, are red in colour, and can be used for dyeing. Dioxypyrenequinone can also be obtained by treating one molecule pyrenequinone with two molecules bromine in a closed vessel at 90—115° for 2½ hours, and then heating the light-red dibrom-pyrenequinone with an alkali. —J. T.

Preparation of Rosaniline Dyes. E. Erlenmeyer. Ger. Pat. 30,357, February 21, 1884; and Dingl. Polyt. J. **256**, 324-325.

THE author recommends the preparation of these dyes by the oxidation of certain compounds of methylated amines with primary, secondary and tertiary aromatic amines. Pararosaniline, for example, is to be prepared

by heating 120 parts dimethylaniline, 465 parts aniline, and 920 parts of 75 per cent. arsenic acid, or 123 parts methyl-violet, 501 parts aniline and 558 parts arsenic acid, at 189° C., with agitation, and maintaining this temperature until a test becomes solid on cooling. The mass is boiled in water, the extract is heated with common salt equal in amount to the portion treated with water, and the bluish-green hydrochloride is precipitated with common salt. Or, 180 parts dimethylaniline, 300 aniline hydrochloride, 555 nitro-benzene, and 15 iron-filings; or, again, 205 parts methyl-violet, 582 aniline chlorhydrate, 555 nitro-benzene, and 15 iron-filings, are heated very gradually to 180° with stirring, and maintained at this temperature until a cooled test becomes solid; the mass is then boiled, with the addition of some hydrochloric acid, and the filtered extract is salted out. Corresponding violet and blue dyes, as in the case of methyl-violet by the copper chloride process, can be prepared by oxidising dimethylaniline in combination with diphenylamine, etc., by oxidising with copper chloride. Also the action of a zinc chloride on the compound of methylphenylnitrosamine, with dimethylamine and analogous compounds, produces violet and blue dyes.—J. T.

Formation of Quinones from Paramethylated Amines. E. Noelting and T. Baumann. Bull. Mulhouse, 1885, 305.

THE authors find that quinones are formed in the oxidation of the paramethylated amines by chromic acid, provided the latter is added in sufficient quantity. The following are the proportions of the reagents employed in the authors' experiments:—Base 5, water 500, chromic acid 15, sulphuric acid (60° B.) 25:—

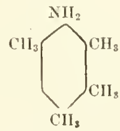
Paratoluidine gave traces only of the quinone. *Metaxylidine*, $C_6H_3.NH_2.CH_3.CH_3$ (1, 2, 4), yielded toluoquinone, $C_6H_3.O.CH_3.O$ (1, 2, 4) (m. p. 70°), in small quantity. *Orthoxylidine* (1, 3, 4) yielded a quinone, but the quantity obtained (from 4grms.) was too minute for identification. *Mesidine*, $C_6H_2.NH_2.(Me_3)$ (1, 2, 4, 6), yielded metaxyloquinone, $C_6H_2.O.CH_3.O.CH_3$ (1, 2, 4, 6), melting at 72°. The yield in this case was large, 5grms. of the base giving 2grms. of the quinone. *Pseudocumidine*, $C_6H_2.NH_2.(Me_3)$ (1, 2, 4, 5), yielded the corresponding quinone. A quantity equal to 20 per cent. of the weight of the original base was obtained in the pure state (m. p. 123°); a further quantity which remained dissolved in the mother-liquor was converted into the hydroquinone (m. p. 210°) which was isolated (comp. *J. Prakt. Chem.* 23, 429. *Isoduridine*, $C_6H.NH_2.(Me)_4$ (1, 2, 3, 4, 6), under the same treatment, yielded a cumoquinone which was converted into the corresponding hydroquinone (m. p. 169°) by the action of sulphurous acid upon the aqueous distillate from the mixed products of oxidation. The quinone was subsequently obtained by oxidising the hydroquinone. It is liquid at the ordinary temperature of the air, crystallising in yellow needles at 11°.—C. F. C.

Some Derivatives of Pseudocumidine. E. Noelting and T. Baumann. Bull. Mulhouse, 1885, 309.

THE authors having previously shown that a crystalline cumidine is formed by the action of methyl-alcohol upon the hydrochlorate of both para- and orthoxylidine, and that its constitutional formula is, therefore, $C_6H_2NH_2.(Me_3)$ (1, 3, 4, 6), have now established the identity of this base with that obtained by Schäper (*Zeit. Chem.* 1867, p. 12) by amidating pseudocymene (comp. Hofmann, *Berl. Ber.* 15, 2895). In the course of their researches the authors have prepared the following derivatives:—

Acetocumidine: White needles, soluble in alcohol, slightly in water, m. p. 161°. *Diazoamidocymene* was obtained by diazotating the base, and treating the product with cumidine in acetic acid solution. It crystallises in transparent tables (m. p. 130°). *Amidoazopseudocymene* was obtained by heating the diazo product (20 pts.), with cumidine (40 pts.), and cumidine hydrochlorate (13 pts.), at 80°. From the product, after distilling away the excess of cumidine, the amidoazo compound was dissolved out by means of ether, and precipitated by hydrochloric acid from its ethereal solution. The free base crystallises from its solution in alcohol, in orange-coloured plates (m. p. 138°). By reduction with stannous chloride it is converted into a mixture of cumidine and cumylenediamine, from which the latter is easily isolated. It crystallises in white needles, m. p. 91°.

An amidotetramethylbenzene was formed by heating the hydrochloride of cumidine with methyl-alcohol at 200—300°. It was obtained as a liquid boiling at 245—250°, crystallising at −10°. The hydrochloride crystallises in white needles. Mesidine similarly treated yielded an identical amidotetramethylbenzene. The base in question was, moreover, found to be identical with that recently isolated by Hofmann (*Ber.* **17**, 1912) from amongst the by-products of the transformation of xylidine into cumidine. It is hence to be regarded as a derivation of isodurene, and may be designated isoduridine.



—C. F. C.

The Use of Poisonous Colours. Chem. Zeit. **47**, 832.

AT the meeting of the Verein zur Wahrung der Interessen der Chemischen Industrie Deutschlands held on April 25, the report of the commission appointed to consider the use of poisonous colouring materials was adopted. The commission defined poisonous colouring materials to be all those colours or colour preparations which contain:—A. Antimony, arsenic, lead, chromium (with the exception of pure chromium oxide), copper, mercury, cinnabar, gamboge, and picric acid; B. Barium (but not barium sulphate), heavy spar, cadmium, zinc, and tin. The use of all these for colouring foods or food stuffs is forbidden. Those enumerated under section A should be so packed for transit as to render the loss of any of the poisonous substances impossible, and, with the exception of lead chromate, are not to be used for colouring toys. The use of arsenic for wall papers is forbidden. Wall-paints containing copper and arsenic are to be discontinued. The sale of articles coloured with poisonous materials as above defined is to be made illegal. The report has been forwarded to the German Government.—S. R.

Valuation of Indigos. (Abstract of a paper read before the Society of Dyers and Colourists.) Ch. Rawson. Jour. Soc. Dyers and Colourists, 1885, 74.

THE principal colouring matter in indigo is indigotin, in addition to which indigo red, indigo brown, indigo gluten, and mineral matters are present. The different shades obtained in the dye-bath are due to the indigotin and indigo red present; the other bodies producing little or no effect. The methods of analysis may be classed under the following heads:—

I. By oxidation of sulphindigotic acid.
II. By loss on sublimation.
III. By reduction to indigo white in an alkaline solution.

I. *Oxidation of Sulphindigotic Acid.*—To obtain a solution of sulphindigotic acid, 1grm. of finely-powdered indigo is intimately mixed in a small mortar with its own weight of ground glass. The mixture is gradually and carefully added during constant stirring with a glass rod to 20cc. of concentrated H_2SO_4 (sp. gr. 1·845) contained in a cylindrical porcelain crucible (cap. 1½oz.); the mortar is rinsed out with a little powdered glass, which is added to the contents of the crucible, and the whole is exposed in a steam-oven for a period of one hour to a temperature of 90° C. The sulphindigotic acid thus formed is diluted with water and made up to a litre. The solution must be filtered, in order to separate certain insoluble impurities, which otherwise would interfere with the subsequent operations. 50cc. of the clear solu-

tion are measured into a porcelain dish, to which are added 250cc. of distilled water. To this diluted liquid a solution of permanganate of potash (0·5 grm. per litre) is gradually run in from a burette until the liquid, which at first takes a greenish tint, changes to a light yellow, the sulphindigotic acid being converted by oxidation into a yellow body named sulphiatic acid. According to the equation—

$$5C_8H_5NOSO_3 + K_2Mn_2O_8 + 3H_2SO_4 = 5C_8H_5NO_2SO_3 + K_2SO_4 + 3H_2O + 2MnSO_4$$

It would appear that indigo-red acts upon "permanganate" in the same way as indigotin, whereas indigo-brown is precipitated from its solution in strong H_2SO_4 on diluting, and does not affect the result; but indigo-gluten and the mineral portion strongly decolourise "permanganate." As indigo-red cannot be regarded as an impurity, the inaccuracy in the analysis may be chiefly ascribed to the gluten and mineral impurities. To eliminate this source of error, the author makes use of the property of sodium sulphindigotate, being almost insoluble in solutions of common salt. The 50cc. of the filtered solution of indigo, instead of being directly titrated with permanganate, are mixed in a small flask with 50cc. of water and 32grm. of common salt. The liquid, which is almost saturated with the salt, is allowed to stand for two hours, when it is filtered, and the precipitate washed with about 50cc. of a solution of salt (sp. gr. 1·2). The precipitated sulphindigotate of soda is dissolved in hot water, the solution is cooled, mixed with 1cc. sulphuric acid and diluted to 300cc. The liquid is then titrated with potassium permanganate as before. A small correction is necessary, owing to the slight solubility of the sodium sulphindigotate in the salt solution. For 0·05grm. of the indigo sample 0·0008grm. must be added to the amount of indigotin found.

The potassium ferricyanide method of Allgren is not recommended by the author, the results obtained being too high.

Hyposulphite Method.—This process, which was recommended by A. Müller (*American Chemist*, v. p. 128), depends upon the fact, that a solution of sodium hyposulphite (not *thiosulphate*) reduces sulphindigotic acid quantitatively to disulpho-leucindigotic acid. A flask of 100cc. capacity is loosely filled with twisted sheet zinc, which is covered with a solution of sodium bisulphite (sp. gr. 1·30). The flask is corked and allowed to stand for about an hour. The liquid is now decanted, and well mixed in a large flask or bottle with five litres of distilled water, containing in suspension about 50grm. of recently-slaked lime. The vessel is closed to prevent access of air, and, after allowing insoluble matters to subside, the clear liquid is syphoned off into a convenient stone bottle, and about 100cc. of petroleum oil poured on the surface of the liquid to prevent oxidation. The bottle is fitted with a cork with two tubes, one of which is in the form of a syphon, and is used to fill the burette; the other tube, which only just passes through the cork, is connected with a supply of coal-gas. A further precaution is to cover the bottle with a sheet of black paper. The solution may be standardised either by pure indigotin or by an ammoniacal solution of copper sulphate, using in the latter case indigo-carmine as indicator. The copper solution is prepared by dissolving 1·904grm. (equal to 1grm. indigotin) of the crystallised salt, $CuSO_4.5H_2O$, in a litre of water containing 100cc. strong ammonia (sp. gr. ·880); 50cc. of this solution are measured into a wide-mouthed flask (capacity 200cc.) boiled to expel air and allowed to cool. The flask is provided with a caoutchouc stopper, perforated with four holes, into two of which are fitted two Mohr's burettes, one containing the hyposulphite solution, and the other the indigo-carmine. The two other apertures serve for the entrance and exit of a current of hydrogen or coal-gas. The burette containing the "hyposulphite" is furnished with a perforated cork, through which passes a glass tube connected with a supply of coal-gas; and at the lower extremity a glass tube is joined to it, which is in connection with the bottle filled with sodium hyposulphite. By this means the burette can be refilled without fear of oxidising the hyposulphite solution. The flask containing the 50cc. of copper sulphate is attached to the caoutchouc stopper, and the air is expelled by a current of coal-gas, which should first pass through U-tubes containing ferrous hydrate. The solution of "hyposulphite" is now gradually run in until the liquid becomes nearly colourless, when a few drops of indigo-carmine are added from the other burette, and, finally, a further quantity of hyposulphite, until the solution assumes a peculiar brownish-red colour. The quantity of hyposulphite used to decolourise the few drops of indigo-carmine solution is very small, but by determining the strength of the two liquids the amount thus consumed can be easily calculated, and then deducted from the number of cc. of copper sulphate solution. 50cc. of copper sulphate are equivalent to ·05 indigotin, so that supposing 25cc. of sodium hyposulphite have been required for the titration, each cc. of the hyposulphite will correspond to ·002 indigotin. The preparation of the sulphindigotic acid solution is the same as that already given. The measured quantity to be analysed is boiled to expel air and allowed to cool. The flask is then attached to the burettes, and after driving out the air by a current of coal-gas, the hyposulphite solution is gradually added during constant agitation. The advantage of this method is that neither indigo-gluten, indigo-brown, nor indigo-red have any appreciable effect upon the estimation of the indigotin. The only substance which affects the result is iron in the ferric state; but it is only in the lower classes of indigo that iron is present to any appreciable extent, and in those cases it exists, or is subsequently reduced to the ferrous state.

II. *Sublimation.*—The method proposed by C. T. Lee (*Chem. News*, August 1, 1884), *loc. cit.*

According to the author, great accuracy in the results by this method cannot be ensured. He finds that indigo-gluten, indigo-brown, and indigo-red are all more or less affected by this method, and that pure indigotin leaves a residue occasionally amounting to 10 per cent. As a rule, inferior qualities of indigo yield results by this process which are too high, whilst, on the other hand, indigoes rich in indigotin give results undoubtedly too low.

III. *Reduction of Indigotin in an Alkaline Solution.*—Of all these processes the two recommended by the author are that of Crace-Calvert, by means of ferrous sulphate and sodium hydrate, and that introduced by himself, by means of sodium hyposulphite and lime. The latter, he considers, gives the best results of any process hitherto published. This process is as follows: One gramme of finely-powdered indigo is ground into a thin paste with water, and introduced into a flask with 500cc. to 600cc. of lime water. The flask is furnished with an indiarubber stopper, which has four perforations, in one of which is inserted a syphon closed by a pinch-cock, and in another is fixed a funnel provided with a stop-cock; the other two apertures serve for the entrance and exit of a current of coal-gas. The flask is connected with a supply of coal-gas, and the contents heated to about 80° C.; 100cc. to 150cc. of a solution of sodium hyposulphite are now introduced by means of the funnel, and the mixture, which in a few minutes takes a yellow tint, is kept near the boiling point for half-an-hour. After allowing the insoluble matters in the flask to subside, 500cc. are syphoned off, and the remaining liquid accurately measured. The sodium hyposulphite used was five times the strength of the solution previously described. The 500cc. are poured into a flask, and by means of an aspirator a current of air is drawn through the liquid for about twenty minutes. The excess of hyposulphite is thus oxidised to sulphite, and the indigo-white to indigo-blue. An excess of hydrochloric acid is now added to dissolve any carbonate of lime which the precipitate may contain. The precipitate is washed upon a weighed filter with hot water, dried at 100°, and weighed. The weight thus obtained is indigotin and indigo-red. If it is desired to determine the amount of each of these, the filter with its contents is placed in an extraction apparatus, and the indigo-red dissolved by means of alcohol.—J. B. C.

Valuation of Indigo. Ch. Rawson. Jour. Soc. Dyers and Colourists, 1885, 211.

THE author criticises a paper by Dr. Rau (*Amer. Chem. J.* 1885, p. 7) on a modification of Fritzsche's method for the determination of indigo according to which the sample of indigo is reduced by grape sugar and sodium hydrate in an aqueous alcoholic solution. As the author was led to expect from the solubility of indigo-red in alcohol, the reduced indigo when decanted and precipitated by a current of air consists of pure indigotin, indigo-red remaining in solution. The estimation of indigotin is not in itself sufficient to determine the value of a sample of indigo.—J. B. C.

Condensation of Chloral-hydrate with Tertiary Amines. P. Boessneck. Ber. **18**, 1516.

THE author has repeated the researches of E. and O. Fischer on the condensation of chloral with dimethylaniline, with the following results. The condensation was effected in presence of $ZnCl_2$, the product dissolved in dilute HCl, and the bases separated with ammonia. The condensation products which become semi-solid upon standing are treated with ether, which dissolves dimethylaniline and another base to be referred to, whereas the methyl derivative of pentaphenylethane discovered by O. Fischer remains undissolved.

The ethereal solution containing the new base is evaporated, and the oily residue treated with steam to eliminate the free dimethylaniline. A black half-solid substance remains, which with an excess of HCl changes to a crystalline mass—the hydrochloride of the base. By filtration and washing with alcohol the crystals are obtained colourless, and by recrystallisation from water, chemically pure, about 25 per cent. of the hydrochloride is obtained on the original quantity of chloralhydrate. The free base separates on addition of alkalis in an oily form; but rapidly becomes crystalline (m. p. 111°). By heating with alkalis, the smell of chloroform is at once apparent. From this fact and the results of analysis the substance is supposed to possess the following constitutional formula: $Cl_3 \equiv C - C.OH.H.C_6H_4N(CH_3)_2$, to which the author gives the name of dimethylamidophenyl-oxy-trichlorethane. Further experiments have shown that by modifying the method of preparation—*i.e.*, by allowing the action to proceed in the cold, the formation of the pentaphenylethane derivatives is avoided, and a larger yield of the new base obtained.

As observed, the action of boiling alkalis produce decomposition with formation of chloroform. If the operation be conducted in a flask connected with a condenser, and steam passed into the alkaline liquid, chloroform is found to collect in the receiver, at the same time a colourless substance distils and crystallises in the condenser. From the melting point and properties the authors consider it to be dimethylamidobenzaldehyde, decomposition occurring as follows:

$$(CH_3)_2N - C_6H_4.OH.HC - C \equiv Cl_3 + H_2O$$
$$= CHCl_3 + C_6H_4N(CH_3)_2.COH + H_2O.$$

—J. B. C.

Reduction Products of the Nitroazo Compounds and Azonitrolic Acids. T. v. Janovsky. Monatsh. Chem. 1885, 455.

THE present paper is a continuation of former researches (this Journal, 1885, 397), with a view to fixing the constitution of the nitrolic acids derived from nitroazo bodies. From the analysis two formulæ are possible—

$$C_6H_5N = NC_6H_4N(OH) - (HO)NC_6H_4N = NC_6H_5 \text{ and}$$
$$C_6H_5N = NC_6H_3 - NOH.$$

The position of the group $-$N.OH is determined by that of the nitro-group in the original substance. On reduction the nitrolic acid gives an amidoazobenzene identical with that obtained from diazoamidobenzene. The red oil obtained as by-product in the preparation of nitroazobenzene is dimetadinitroazobenzene yielding on reduction *m*-phenylenediamine.

By partial reduction of *m*-dinitroazobenzene, a semi-solid nitrolic acid is formed, which dissolves in alkalis on heating with a violet blue colour. The analysis indicates the presence of only one "nitrol" group. If the boiling alcoholic solution be reduced with ammonium sulphhydrate until alkalis no longer give a blue colouration, but a deep green, the solution has a gold-brown colour, the product formed being *m*-diamidoazobenzene—

$$NH_2C_6H_4N = NC_6H_4NH_2(NH_2 : N = 1:3).$$

This compound is therefore a symmetrical isomeride of chrysoidine. It dyes wool and silk a yellow colour. By nitrating the red oil with excess of fuming nitric acid two nitro-products are formed, one being soluble, the other insoluble in glacial acetic acid.

By partial reduction of *p*-dinitroazobenzene a nitro-nitrolic acid is obtained (this Journal, 1885, 397), which on further reduction with ammonium sulphide in alcoholic solution yields di-*p*-diamidoazobenzene. This is not identical with diphenin (di-*p*-amidohydrazobenzene. Nitrate of silver added to a solution of a salt of this base gives a yellow-brown precipitate, which dissolves in hot water and crystallises out on cooling. This silver reaction appears to be common to all amidoazobenzenes. This body colours silk yellow, and is the second isomeride of chrysoidine, having the formula—

$$NH_2C_6H_4N = NC_6H_4.NH_2(N:NH_2 = 1:4).$$

With cold fuming nitric acid, mononitroazobenzene yields a trinitro product (m. p. 180°), and the same compound may be prepared from azobenzene and *p*-dinitroazobenzene. A second trinitro compound is obtained by acting on *p*-dinitroazobenzene in the cold with fuming nitric acid (m. p. 169°), which explodes on heating above its melting point. The formulæ of these two bodies will probably be, $NO_2C_6H_3 = NC_6H_3(NO_2)_2$ (3:4) and

$$NO_2C_6H_3 = NC_6H_3(NO_2)_2 \ (2:4)$$

By decomposition *p*-phenylenediamine and triamidobenzene are formed. Trinitroazobenzene gives a nitrolic acid on reduction. These nitrolic acids are fundamentally different from those of the fatty series, and also differ from the hydroxamic and hydroxamic acids, which are prepared with hydroxylamine. The name nitrolic acid has been retained on account of the group .N.OH which is present. From these considerations, and from the fact that the analyses of these compounds indicate a quantity of hydrogen less than that required in the first formula given, the author considers the following to represent the constitution of this class of bodies, $C_6H_5N = \overset{1}{N}C_6H_3 = \overset{3\ 4}{N}.OH$.—J. B. C.

Improvements in Producing Yellow Colouring Matter suitable for Dyeing and Printing. W. W. Grieve, Glasgow. From the "Farbenfabriken vormals Friedrich Bayer & Co.," Elberfeld, Germany. Eng. Pat. 9606, July 1, 1884.

THIS invention is a development of the specification, 9162, June 19, 1884, and consists in substituting tetrazoditolyl or tetrazodixylyl for the tetrazodiphenyl described in the previous provisional specification. The tolyl and xylyl bases are prepared from nitrotoluene or nitroxylene by a process analogous to that employed in making benzidine from nitrobenzene. The colouring matter is produced by combining the tetrazo-compounds with salicylic acid.—R. M.

Improvements in the Preparation of Purple Colouring Matter suitable for Dyeing and Printing. J. H. Johnson, Lincolns' Inn Fields. From H. Caro, Mannheim, Germany. Eng. Pat. 11,030, August 7, 1884.

THIS invention is an improvement upon the patent No. 4428, September 15, 1883, in which it was stated that zinc chloride was inferior to aluminium chloride as a condensing agent in effecting condensation between carbon oxychloride and dimethylaniline or analogous tertiary bases. The inventor now shows that by a modification of the original process zinc chloride can be equally well employed, and as an example the following

method of preparing crystallised methyl purple is given; 100 parts of dimethylaniline are mixed with 18 to 20 parts of phosgene (introduced in the gaseous state) at a temperature of 20° C. The supply of $COCl_2$ must be regulated so as to keep the temperature below 30° C., and the mixture when complete is allowed to stand at the ordinary temperature for about twenty-four hours. Fifty parts of dimethylaniline and 30 parts of dry powdered zinc chloride are then added and the mixture kept well agitated, while phosgene gas is gradually passed in at a temperature of 40° to 50° C. till the mixture has increased in weight by about 20 parts, after which the temperature is maintained at about 50° C. for about six hours, by which time the production of the colouring matter is completed. The present process differs from the original in the use of a different condensing agent and in being carried out in two stages. —R. M.

Improvements in the Manufacture of Colouring Matters Suitable for Dyeing and Printing from Tetramethyldiamidobenzophenone and Analogous Ketone Bases. J. H. Johnson, Lincolns' Inn Fields. From H. Caro, Mannheim, Germany. Eng. Pat. 11,159, August 11, 1884.

THIS invention is a further development of the process formerly described by the author for the preparation of triphenylmethane derivatives from tetramethyldiamidobenzophenone and analogous ketone bases (Patents No. 4850, March 13, 1884; No. 5038, March 18, 1884; No. 5512, March 26, 1884; and No. 5741, March 31, 1884). In the former patents carbon oxychloride is specially mentioned as a suitable reagent for converting the ketone bases into their haloid derivatives, and the inventor now points out that certain derivatives of carbon oxychloride obtained by chlorinating the chlorocarbonic ethers can be used in a similar manner to carbon oxychloride. The chlorocarbonic ethers are prepared according to the usual method by the action of the alcohols upon carbon oxychloride, and the chlorine derivatives are obtained by passing dry chlorine into the ethers as long as the gas is readily absorbed, the reaction requiring moderation by cooling at the commencement and assisting by heat towards the end. The most active reagent is the chlorine derivative of methyl chlorocarbonate and the activity of the compounds decrease with the increase of molecular weight—*i.e.*, as the homologous series is ascended. The preparation of colouring matters is carried out in a similar manner to that described in the previous patents, and the specification contains examples showing the application of the process to the production of the various colouring matters from the chlorine derivatives of tetramethyldiamidobenzophenone when condensed with secondary and tertiary amines and quinoline.—R. M.

Process or Processes for the Production of Soluble Combinations of certain Azo-Compounds with Bisulphites, and for utilising the same in Dyeing and Printing. H. J. Haddan, 67, Strand, Westminster. From Eugen Frank and the "Farbenfabriken vorm. F. Bayer & Co.," Elberfeld. Eng. Pat. 2206, February 17, 1885.

THE azo compounds referred to are:—(1) Diazoazobenzene and its homologues; (2) Benzidine and its homologues (diazotised); (3) α- and β-diazonaphthalene with the two β-naphtholmonosulphonic acids; (4) Diazoazobenzenemonosulphonic acid and its homologues with α- and β-naphthol. On treating the foregoing compounds in a finely-divided state with acid sulphites in hot aqueous or alcoholic solution they dissolve and become soluble in water with a yellow colour. By the action of alkalis or heat these double compounds are decomposed into their constituents, so that cotton or any other fibre can be dyed or printed by first applying the soluble compound and then steaming or boiling.—R. M.

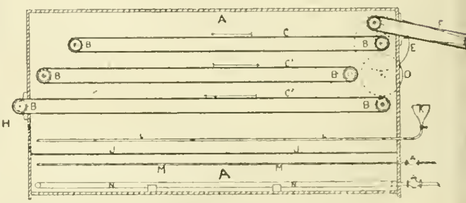
V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Improved Method of treating Wood and Vegetable Fibres for the Manufacture of Textile Fabrics. Alexander Wilkinson. Eng. Pat. 10,194, July 15, 1884.

CERTAIN methods of bleaching are proposed as substitutes for the usual ones.—E. J. B.

Improvements in the Method of and Apparatus for Neutralising the Acid in Extract Fibre. Samuel Law. Eng. Pat. 10,400, July 21, 1884.

THIS invention relates to certain improvements in apparatus for neutralising the acid contained in wool, silk, or other animal fibre, after it has undergone the operation of carbonisation for removing vegetable matter. The material passes by means of the endless apron F into the rectangular chamber A. It then drops on to

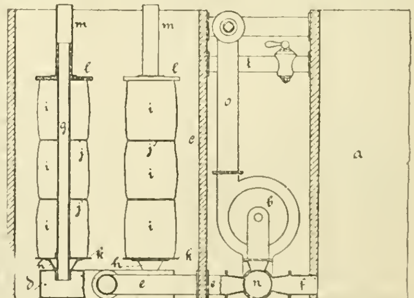


the sheet C, and is carried forward to the other end where it drops on to C¹. From thence it is carried forward and again dropped on to C², by which it passes to a hopper placed at H. J is a perforated shelf, below which are the steam pipes M and N, M being perforated. Solution of ammonia is supplied by means of the funnel K and perforated pipe L.—E. J. B.

A New or Improved Apparatus for, and Method of Chemically treating Wool, Cotton and other Soft Goods. Lorentz Albert Groth. From Henry Giesler. Eng. Pat. 10,439, July 22, 1884.

THE apparatus is shown in Figs. 1 and 2. The material to be treated, in the form of slubbing, rovings or slivers, is wound in coils round the perforated pipe *g*, the coils being separated from each other by discs *j*. The liquid

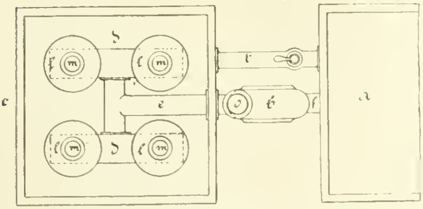
FIG. 1.



contained in the reservoir *a* runs by the pipe *f*, through the cock *n*, the pipes *e* and *d*, and the perforated pipe *g*, through the material into the vessel *c*. As soon as a proper level is obtained, the pump C is set in motion, and the

liquid is drawn back through the material, and returns by way of the pipe *o* into the reservoir *a*. The specifica-

FIG 2.



tion contains other drawings showing slight unimportant modifications of the above.—E. J. B.

Improvements in the Manufacture of Fibrous Material from Wood for Surgical and other Purposes. Henry Harris Lake. From Josef Odelga. Eng. Pat. 2987, March 6, 1885.

THE inventor claims the preparation and use of the long thread fibrous material obtained by scraping strips or blocks of wood, which material is similar to linen lint, and may be used as lint for surgical purposes, or as filling material, and may be spun into yarn, and in the form of spun yarn be used in the manufacture of woven fabrics, cord, braided articles, netting, embroidery, and knitted goods.
—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Note on Printing Blue Grounds. M. O. Breuer. Bull. Mulhouse, p. 532, 1884.

DIFFICULTIES experienced in printing blue grounds with Alkali blue 5B. have suggested the method described, which was successfully used for years for printing violet. The addition of 15 per cent. of ammonia caused complaints respecting uneven grounds to cease. The blue made with Alkali blue 5B., and treated in this manner, was in itself an improvement, but perfection was only attained by proceeding as follows:—The blue 5B. was first decomposed by an acid, and dissolved in ammonia. The following are the formulæ:—

For the blue—

Alkali blue 5B.	1,000	grams.
Water	10,000	,,

Dissolve and precipitate with—
100 grams of HCl at 21° Bé., decant and filter: The result is 10,000 grams of blue paste.

Printing colour—

Blue paste as above	2,000	grams.
Ammonia	350	,,
Glycerine	500	,,
Dry gum senegal	1,100	,,

Reduction—

Gum water	1,000	grams.
Ammonia	35	,,
Glycerine	75	,,

Print on wool mordanted with tin, damp before steaming, steam 60 minutes and wash. These remarks bear out a fact known some time already, and which perhaps might repay study—viz., that the addition of ammonia improves all printing colours made with aniline colours properly so called, as well as those popularly so called. Almost all are improved thereby, even those which ought not to be affected at all, such as, *e.g.*, the ponceaux R, 2 R, and 3 R, which are all salts and not acids. It has also been noticed that in printing light blue grounds on silk, the addition of ammonia to aniline colours has been of another advantage. It was found thereby possible to avoid the presence in light blue grounds of little light and sometimes even white spots with which previously the grounds were sown, and which were simply due to calcareous soap, resulting from careless soaping. Ammonia proved to be a solvent for the substances producing these marks.—H. A. R.

Chrome Discharge of Indigo Blue. A. Scheurer. Bull. Mulhouse, 1885, 316.

THE process of fixing an alumina mordant simultaneously with the discharge of a dyed indigo blue, by means of a mixture of aluminium chloride and potassium bichromate, printed upon the cloth and steamed, is attended with the disadvantage that in the after-process of dyeing with alizarin the shades produced are lacking in brightness. Better results are obtained by substituting aluminium oxalate for the chloride, in which case an acid (oxalic) requires to be added. In comparing the alizarin shade produced upon an original and a discharged white (indigo), each of which had been printed with this mixture and steamed, those upon the former were found to be considerably brighter. A probable explanation of the inferior colour upon the discharged ground is the retention of a chromic oxide in combination with a product of oxidation of the (discharged) indigo.—C. F. C.

Use of Oxalate of Antimony in Printing. E. Jacquet. Bull. Mulhouse, 1885, 318.

THE author recommends a mixture of basic antimony oxalate and ammonium oxalate as a substitute for tartar emetic in the fixation of tannin, and, therefore, of those colours which require the tannin mordant—*e.g.*, methylene blue. The basic salt is prepared from the antimony-potassium oxalate by precipitation with ammonia, and is added in the form of paste together with twice its weight of ammonium oxalate, to the mixture of colouring matter, tannin, etc., in the usual proportions. After steaming the goods are cleared in the usual way, but with the addition of chalk to the bath in order to neutralise the oxalic acid.—C. F. C.

Development of Aniline Black. C. Zurcher. Bull. Mulhouse, 1885, 319.

THE tardy development of aniline black upon the fabric from the usual printing mixtures, at temperatures between − 13° and + 13°, the author refers to a separation of the aniline salt from the liquor, which appears from his observations to be especially favoured by certain conditions of humidity and of movement of the surrounding atmosphere.—C. F. C.

Starch as a Substitute for China Clay in Printing. O. Breuer. Bull. Mulhouse, 1885, 322.

THE author finds that starch, made into a paste with water in the cold, is a perfect substitute for China clay for printing in reserve for indigo blue, and for many other purposes, especially for printing upon silk. It may be used in quantities of from 250 to 400 grammes per litre of thickening, without causing any undue hardening of the fabric.—C. F. C.

A Reducing Vat for Indigo and Blue-Black. C. Collin and L. Benoist. Ger. Pat. 30,449, Feb. 29, 1884.

IN order to avoid detrimental fermentations in preparing the vat, the inventors propose to employ a completely fermentescible food material, and a pure ferment. For a vat of 8000 litres, 16kilos. of flour or starch are boiled for a few minutes in water containing 1·6kilo. of sodium carbonate. The starch paste is transferred to the vat, and 8kilos. of glucose, 5·38kilos. of soda, and 1kilo. of magnesia are added. Magnesia is better adapted for the neutralisation of the lactic butyric and other acids formed than lime. With this vat, the amount of alkali necessary to combine with the above-named acids and to form the indigotic salt may be calculated with fair accuracy. As, however, the alkalinity

of the vat at the commencement would be too high if the total amount of alkali were to be added at once, there is added upon the first day only one half of the soda required to neutralise the acids formed, in addition, of course, to the alkali required for the formation of the indigotic salt. This is calculated to be 230grm. of soda for 1kilo. of indigo. Whilst the vat is being worked, an addition of 2kilos. of starch paste and 2kilos. of glucose (daily) will suffice for 100kilos. of wool dyed per diem. With pure indigo, this method gives 40 per cent. better results, with mixed indigo and blue-black 65 per cent. better results, than the old reduction plan. The ferment, *desmobacterium hydrogeniferum*, is obtained pure by the following cultivation process:—100grm. of potato cuttings are allowed to digest for some time in 500cc. of water, at 40° to 44° C. The liquid soon becomes peopled with micro-organisms, amongst which is the desmobacterium. A flask is now filled with 1·5grm. phosphate of soda, 3grm. tartrate of ammonia, 5grm. of glucose, 5grm. of soluble starch, 3grm. of sodium carbonate, 0·5 grm. of lime, and 1litre of water. The flask is provided with a doubly-bent tube, which dips into a large evaporating basin containing 200cc. of water. The contents of the flask and basin are boiled for twenty minutes to effect sterilisation, and also to expel air, and then 50 to 60cc. of the liquid containing the desmobacteria are introduced into the basin, the boiling being at the same moment discontinued. The contents of the basin are slowly sucked into the flask, and when this has cooled down sufficiently for the hand to touch it without inconvenience, the bent tube is dipped under mercury, and the whole maintained for four or five days at a temperature of 38° to 40° C. At the end of this period, the desmobacterium will be in full activity, and in a pure condition; the liquid is then to be absorbed by wood flour sterilised at 150° in the proportion of three parts of the flour to two of liquid. The moist wood flour is dried at 40° to 45°, and the ferment thus obtained preserved in well-closed bottles. Of this prepared ferment, 50grm. suffice for a vat of 12cbm. contents.
—W. D. B.

Improved Apparatus for Dyeing. W. D. Thornton, Bradford. Eng. Pat. 10,042, July 11, 1884.

THE object of this invention is to dye wool in the sliver, loose, and also when spun into yarn; also cotton in various stages of manufacture, in less time than hitherto. The fibres to be dyed are placed in an air-tight vessel, a vacuum is created inside the vessel, and the dye-liquor admitted by opening a valve. Owing to the vacuum previously present, penetration is rapidly completed, and the dyeing rendered uniform. The liquor is finally drawn off by an ejector, which can be done in much less time than possible by gravity alone.
—H. A. R.

Improvements in the Application of Chloride of Lime for Bleaching Purposes. George Lunge, Zürich. Eng. Pat. 11,333, August 16, 1884.

HYDROCHLORIC, sulphuric or oxalic acids, when used as a means of liberating chlorine, do so as free chlorine, which injures fibres, machinery and health of workmen. Carbonic acid liberates hypochlorous acids instead of free Cl, but its gaseous form is not convenient. It is proposed to employ acetic acid, or another weak organic acid of an analogous nature. A very small quantity is sufficient, as it acts over and over again. The reactions taking place are the following:—

(1) $2(CaOCl_2)+2(C_2H_4O_2)=Ca(C_2H_3O_2)_2+CaCl_2+(HOCl$
(2) $2(HOCl)=2(HCl)+O_2$
(3) $Ca(C_2H_3O_2)_2+2(HCl)=CaCl_2+2(C_2H_4O_2)$.

No free acid is thus ever present, which is a great advantage, especially with short fabrics. The acetic acid may be either added to the bleaching liquor at first, or the acid used along with the bath subsequent to soaking in bleach liquor. It is claimed that less bleaching powder is required, and that the water courses are less fouled.—H. A. R.

Improvements in Dyeing Cotton Yarns and Fabrics. F. A. Gatty, Accrington. Eng. Pat. 11,456, August 20, 1884.

THIS invention consists in an improved method of dyeing certain fast and permanent colours from olive to brown, by means of the oxides of chromium and iron in varying proportions, according to the shade required. For an olive shade, the inventor takes five gallons of chrome alum solution at 10° Tw., and 1 gallon of $FeSO_4$ at 1½lb. per gallon, or else an equivalent quantity of another soluble iron salt. For brown, the quantity of iron is increased according to shade, and the goods are then squeezed in a suitable manner. The next process is a passage through soda solution at 4° Tw. or more, and at a temperature of 140° to 150° F. approximately. The subsequent treatment of the dyed goods presents nothing unusual.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Preparation of Stannic Chloride. L. A. Czimatis (Ger. Pat. 31,550, October 22, 1884). Dingl. Polyt. J. **256**, 332.

ON heating a mixture of stannic oxide and magnesium chloride, or calcium chloride, stannic chloride distils over, and may be condensed. The mass obtained by mixing a solution of stannic oxide in hydrochloric acid with the chloride of an alkali metal, or of an alkaline earthy metal, after evaporation, can be similarly treated.—J. T.

Combination of Oxalic Acid with Alumina. C. Koechlin and L. Mathieu-Plessy. Bull. Mulhouse, 1885, 304.

OXALIC acid in combination with alumina is not immediately precipitated by lime salts. The authors have endeavoured, but without success, to take advantage of this property in the employment of the latter as mordants. Their researches, however, established the following relationships of affinity:—(1) Tribasic aluminic sulphate (hydrated) dissolves in a solution of neutral ammonium oxalate; (2) hydrated aluminic oxide likewise; (3) cryolite is attacked by a solution of oxalic acid at high temperature (150°).—C. F. C.

Use of Koerting's Apparatus for Facilitating the Passage of Gases from Pyrites Burners to the Lead Chambers. A. Scheurer-Kestner. Bull. Mulhouse, 1885, 348. (Sealed Packet, October, 1877.)

THE author's experiments on this subject commenced at Thann in 1876. After many modifications, a thoroughly satisfactory and economical arrangement of the apparatus has been devised, whereby the steam to supply the lead chambers is intercepted and caused to work the blower. It is found that the steam from 1814kg. water, employed in this way, will produce sufficient draught for the combustion of 7000kg. pyrites of 45 per cent. sulphur.—C. F. C.

The Italian Tartar Industry. G. Kaemmer. Chem. Zeit. 9, 939 and 1012.

THE greater proportion of the Italian tartar is obtained from the marc and lees, and sold as half-refined. Cream of tartar is manufactured in Italy, to a very small extent in the south, but somewhat more largely in Piedmont, Tuscany, Lombardy, and generally speaking Upper Italy. The manufacture of tartar—Cremore di St. Antimo—is carried on largely in the south, and has concentrated around St. Antimo, Trani, Barri, and Messina. The lees are collected in the provinces, dried on the spot, and forwarded home, where they are ground in common horizontal mills, boiled in copper boilers, holding about 1200 litres, with from 10 to 12 times their weight of water, and the whole allowed to stand for 5 or 6 days, taking care to prevent the crystals which form at the surface from falling to the bottom. The liquor and crystals are removed from the insoluble portion, and this

is boiled with sulphuric or hydrochloric acid, and potash added subsequently in a thoroughly empirical manner, to effect the conversion of the tartrate of lime into acid tartrate of potash. This second crop of bitartrate is of less purity than that obtained by the first crystallisation, and is mixed therewith. The costs of working, owing to the crudeness of the apparatus, are very small, about 28-34 marks per 100kilos. of tartar. The loss of tartaric acid varies from 8 to 15 per cent., and the above estimate of the cost takes no account of the price of the lees. Well-arranged factories, working with a loss of 4 to 6 per cent. at most, and turning the nitrogenous residues to account, are able to manufacture a better product at a cost of 8 to 12 marks per 100kilos. of tartar. The importance of the Italian tartar industry is seen from the fact that in Southern Italy alone the number of boilers amounts to between 3000 and 3500, corresponding to a production annually of 6,000, 000kilos. of tartar from lees that is more than 10,000,000 marks. The composition of this tartar is upon an average:—

	69·87 per cent.	tartaric acid as potassium bitartrate
	4·06 ,,	,, ,, as calcium tartrate
Total,	73·93 ,,	,, ,, corresponding to
	94·60 ,,	of its salts

The remaining 5·4 per cent. consists of moisture, organic matter, sand (as much as 1 per cent.), iron, alumina, copper, phosphates, and magnesia. The manufacture of Cremore di Vinaccia, directly from the marc of the red grape, is carried on in a more scientific manner and with greater profit than that of Cremore di St. Antimo, since the alcohol obtained is a considerable source of profit. The author estimates the total annual value of this product at 5,000,000 marks, and places the average composition as 60 to 72 per cent. of tartaric acid as potassium bitartrate, 3 to 10 per cent. as tartrate of lime, recent analyses having shown 85·01 per cent of bitartrate, 7·81 of calcium tartrate. The remainder consists for the most part of moisture, sand and organic matters; of iron, phosphates, copper, and alumina, there are less than in the Cremore di St. Antimo. The method of testing, almost universal still for trade purposes, consists in boiling 50grm. of the finely-powdered sample with one litre of water for 6 to 10 minutes, pouring the clear solution into a dish and allowing it to remain at rest for 12 hours. The crystals are then collected, dried and weighed; the weight found multiplied 2 and increased by 10 to correct for solubility, is taken as the percentage of potassium bitartrate. Cremore di St. Antimo is sold upon a basis of 90 per cent., Cremore di Vinaccia upon that of 85 per cent. The manufacture of cream of tartar or refined tartar is not carried on upon a large scale as compared with that of crude tartar. The total production can scarcely be more than 600,000kilos. with a value of 1,500,000 marks; the export is almost exclusively to England. The production of tartaric acid is much hampered by the high price of sulphuric and hydrochloric acids, but amounts to between 200,000 and 250,000kilos. per annum of about three-quarter million marks in value. The greater proportion of this is consumed at home, the remainder exported to England. It is computed that the total value of the Italian wine residues amounts to between 26 and 30 million marks per annum, or 1 mark per hectolitre of wine; by improved methods of working this amount might readily be increased by one-half or even doubled.—W. D. B.

New Applications of the Nitrometer. G. Lunge. Chem. Ind. 8, 161-171.

THE author at first criticises Allen's paper on the same subject, read before the Birmingham Section of this Society on 4th March, 1885. According to Allen, sulphuric acid has "a notable solvent power for nitric oxide," and hence a source of error is introduced, which must not be ignored, but Lunge proves this statement to be wrong (*Ber.* 18, 1391). He also points out here that the nitrometer is an excellent contrivance for determining the solubility of gases in certain liquids under variable pressure and temperature. Another new application of the same apparatus is for reducing volumes of gas to normal pressure and temperature. Lunge also modified Allen's apparatus for the estimation of urea in urine. A small 50cc. beaker fitted with a perforated indiarubber cork is connected by a small piece of strong indiarubber tubing with the nose of the three-way tap of the nitrometer, which is filled with mercury (Allen fills his instrument with a saturated solution of sodium or magnesium sulphate). The beaker, which should be of strong glass, contains a small glass or ebonite tube, provided with a loop of platinum wire (Fig. 1) to facilitate its insertion and withdrawal. Or,

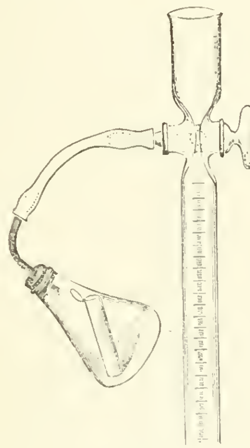


FIG. 1.

better still, the beaker may be replaced by a small bottle, containing a tube fused to the bottom (Fig. 2). The whole must be light enough to be hung on the nitrometer-tap. The same apparatus can, of course, take the place of Knop's azotometer, Scheibler's carbonic acid apparatus, or be used for the assay of commercial peroxide of hydrogen. In the latter case the sample to be tested is filled into the inner tube, while permanganate solution, strongly acidified with sulphuric acid, is placed into the bottle proper. On mixing, oxygen is readily given off, and the quantity of the same is measured in

FIG. 2.

the nitrometer. A very interesting and novel application depending on the same principle and the same reaction is for titrating standard solutions without weighing or measuring a substance of known composition. Supposing a potassium permanganate solution has to be tested for its strength. A certain measured quantity of permanganate is acidified with sulphuric acid, and decomposed with an excess of hydrogen peroxide of unknown strength. The complete decolourisation shows whether an excess was present. If now the volume of oxygen given off be measured in the nitrometer the strength of the permanganate solution can be easily

calculated. It is shown by experiments that this method is very accurate as well as quick. For testing the strength of standard acids (sulphuric, hydrochloric acid, etc.), a measured quantity is treated with an excess of sodium or calcium carbonate, and after reading off the volume of carbonic acid evolved, the strength of the acids can be computed. These examples can be increased by many more. Suffice it to say, that the nitrometer may be used for analytical purposes in all cases where a certain quantity of gas is produced, which after measuring allows of the decomposed substance being calculated. Of course, the gas must not be soluble in the liquid employed for decomposing, nor must it attack mercury. Bleaching powder solution acts on the hydrogen peroxide like permanganate. By means of bleaching powder solution in excess, the strength of hydrogen peroxide can therefore be estimated, and *vice versâ*. Potassium ferricyanide in alkaline solution liberates the oxygen of peroxide of hydrogen, and can therefore be analysed in the same manner. The nitrometer can further serve in analytical operations for absorbing gases. The determination of indigotin and indigo-red in commercial indigo by reduction to indigo-white and measuring the amount of oxygen absorbed, belongs to this class of operations. Another very convenient application is for absorbing gases evolved in manufacturing processes, because of the nitrometer combining the advantages of Bunte's and Hempel's gas burettes with the possibility of manipulating the gases over mercury. If it be required to test fire-gases for carbonic dioxide and oxygen, which is all that is necessary in most cases, the gases are aspirated into the nitrometer-tube, and after cutting off the further supply of the gases, potassium hydrate solution is introduced through the cup into the measuring tube. After shaking, the percentage of carbonic dioxide can be read off. Then some concentrated pyrogallic acid solution is added, and the oxygen estimated. If analyses of gases have to be performed where reagents must be applied which act on each other, the nitrometer is combined with several of Hempel's gas-pipettes. For the analysis of gases dissolved in water, etc., the small beaker in Fig. 1 is filled with the liquid in question, and after inserting the stopper the liquid is raised to the boil, and the heating continued until all gases are driven out. By lowering the reservoir tube the expulsion of gases is greatly facilitated by suction. When the volume does no more increase, the beaker is disconnected by turning the tap, the nitrometer allowed to cool, and the gases are ready for being analysed.—S. H.

On the Inflammability of Vegetable Matter by Nitric Acid. R. Hass. Chem. Ind. **8**, 173.

A CARBOY filled with common nitric acid, 36° B. (1·325), strong, and packed up in the usual manner in a wicker basket with straw, was said to have taken fire spontaneously. The author, therefore, made some experiments in order to find out up to what lowest strength nitric acid is liable to cause spontaneous combustion. The above table renders the details and results of these experiments.—S. H.

No. of Experiment.	Concentration of Nitric Acid.		Packing Material consisting of	Box or Wicker Basket.	Size of the same: Cubic contents.	Time from the moment of wetting packing material with the acid until it took fire.
	° B.	Sp. gr. at 17° C.				
1.	41	1·388	Rough straw.	Wooden box.	3 Litres.	45 minutes.
2.	41	1·388	Sea-weed.	,,	,,	35 ,,
3.	36	1·325	Hay.	,,	12 Litres.	40 ,,
4.	36	1·325	Rough straw.	,,	,,	50 ,,
5.	35	1·313	Hay.	,,	,,	36 ,,
6.	35	1·313	Rough straw.	,,	15 Litres.	2¼ hours.
7.	34	1·301	,,	,,	12 ,,	Strong evolution of vapours, but no flame.
8.	33	1·290	,,	Wicker basket.	20 ,,	(as above)
9.	33	1·290	Fine straw.	Box.	15 ,,	1¾ hour.
10.	32	1·279	Hay.	,,	12 ,,	45 minutes.
11.	32	1·279	Fine straw.	,,	15 ,,	3¼ hours.
12.	31	1·268	Hay.	,,	15 ,,	1 hour.
13.	31	1·268	,,	Basket.	20 ,,	55 minutes.
14.	31	1·268	Fine straw.	Box.	15 ,,	Strong evolution of vapours, but no flame.
15.	31	1·268	,,	Basket.	20 ,,	(as above)
16.	30	1·257	Hay.	Box.	20 ,,	1¼ hour.
17.	30	1·257	Rough straw.	Basket.	20 ,,	Strong heat; no flame.
18.	29	1·276	Hay.	Box.	15 ,,	2¼ hours.
19.	29	1·276	Fine straw.	,,	12 ,,	Strong evolution of vapours, but no flame.
20.	29	1·276	,,	Basket.	20 ,,	(as above)
21.	28	1·236	Hay.	Box.	12 ,,	(as above)
22.	28	1·236	,,	,,	15 ,,	(as above)
23.	28	1·236		Basket.	20 ,,	(as above)

On the Limit of Combination between the Bicarbonates of Magnesium and Potassium. R. Engel. Compt. Rend. **100**, 1224-1227.

FROM previous experiments of the author, potassium and magnesium bicarbonate combine to form sesquicarbonate

$MgCO_3.HKCO_3+4H_2O$, with elimination of CO_2. He has further determined the condition of equilibrium by the mutual action of the bicarbonates—(1) under different pressures of CO_2 (by which the magnesium carbonate is held in solution); (2) under equal pressure, but varying proportions of the two bicarbonates. The experiments show from (1) the decomposition of the double salt at equal temperatures increases with the pressure of CO_2; and from (2), the relation $y = \sqrt{2a-x}$ when x and y are respectively the amount of sulphuric acid necessary to neutralise potassium or magnesium carbonate held in 10cc. of the solution, and a a constant (= 6·25).—J. B. C.

Determination of the Value of Acetate of Lime. A. A. Blair. Amer. Chem. J. 7, 26-31.

THE solution of acetate of lime is precipitated with a weighed quantity of sodium carbonate, and the excess of alkali titrated in an aliquot portion of the filtrate with normal acid, using phenol-phthalein as indicator. If the solution of the acetate is brown in colour, it is filtered through animal charcoal before the addition of the sodium carbonate.—S. R.

Iron Vessel for holding Acids. E. Pohl, Dortmund. Ger. Pat. 30,188, January 3, 1884.

THIS vessel, which is to serve for the storage and transport of nitric acid, etc., consists of a drum lined with asbestos cloth, made impermeable by soaking in a bath of paraffin, stearin or wax.—F. M.

Method for the Preparation of the Anhydrides of Organic Acids. Chemische Fabrik vormals Hoffmann und Schötensaek, Ludwigshafen. Ger. Pat. 29,669, April 9, 1884.

A CURRENT of carbonyl-chloride is passed over anhydrous sodium acetate heated to 140°. The distillate is purified by fractional distillation, 15 parts of it yielding about 10 parts of fairly pure acetic anhydride. Particular care must be taken not to heat the sodium acetate beyond 140°, as otherwise considerable quantities of acetone would be formed, which can scarcely be completely separated from the anhydride. Propionic and butyric anhydrides may be prepared in a similar manner, the anhydrous salts, however, requiring a temperature of 170° and 200° respectively, for their decomposition. In both cases chlorides are formed besides the anhydrides, evidently in consequence of a secondary reaction expressed by the equation $(C_3H_7CO)_2O + COCl_2 = CO_2 + 2C_3H_7COCl$. The chlorides are converted into anhydrides by the well-known methods. Benzoic anhydride can likewise be prepared by this method, the sodium benzoate being heated to 360° while exposed to the action of the carbonyl-chloride. The greater part of the product formed in this case consists of benzoyl-chloride.—F. M.

An Improved Process and Apparatus for the Continuous Production of Carbonic Acid. E. Capitaine, London. From H. Herbertz. Eng. Pat. 8617, June 5, 1884.

THIS improved process comprises the production of carbonic acid free from air as the main product, and of carbonic acid mixed with air as a by-product. Five cylindrical vessels arranged one above the other, provided each with a stirring apparatus, and capable of being heated with steam or by a fire, serve for the reception of the bicarbonate of soda or of potash. The first cylinder is provided with a hopper, by which the finely-ground material is fed in, and the cylinders are connected with each other by tubes at alternate ends, so that the bicarbonate passes along the whole length of the apparatus. The first and fourth cylinders are fitted with domes and gas-escape pipes, by which the carbonic acid is led to cooling worms for the abstraction of its head and some of its moisture, and then through purifying vessels containing sulphuric acid, and finally to gasometers. The gas from the fourth cylinder is free from air.—W. D. B.

Improvements in the Method of and in Apparatus for Extracting Sulphur and Sulphurous Acid from Pyrites. Arthur Charles Henderson, Middlesex. From Léon Labois, Paris. Eng. Pat. 9761, July 4, 1884.

THE arrangements preferred by the patentee for this purpose consist of a retort connected with a condensing chamber and separately heated, placed immediately above a roasting furnace of the Malétra type, in such manner that the heated residue from the former may be immediately raked into the latter through a valved channel temporarily placed against the mouth of the retort. A large percentage of elementary sulphur may be thus distilled off, the residual sulphur being roasted into sulphur dioxide in the second stage and utilised as desired. By a slight modification the ore in the first case charged into and removed from the retort through the door, may be introduced through a hopper placed in its roof, and be raked into the calciner through a cavity in the floor, this channel being effectually closed during distillation by the previous charge. If the situation of the works will not permit of the erection of the distilling furnace immediately above the calciner, the half-treated ore must be conveyed rapidly, while still hot, in a hopper truck from the one furnace to the other. The retort and calciner may be constructed in one, but in order thus to insure satisfactory results the air introduced for the calcination must be heated, preferably by regeneration of the heat from the escaping gases.—W. G. M.

Improvements in the Manufacture of Precipitated Phosphate of Alumina and the Mixed Precipitates of Phosphate of Alumina and Sulphate of Lime. W. A. Hills. Eng. Pat. 10,267, July 17, 1884.

RAW or calcined natural phosphate of alumina is treated with sulphuric acid in the usual way; the resultant solution is separated from the insoluble residue, and the phosphate of alumina is precipitated by diluting the solution with water, preferably hot, or by blowing steam through it until the same result is attained. The inventor finds that sufficient dilution with pure water will cause the precipitation of the alumina salt from the acid solution, but water containing an alkali in solution may also be used if desired, or in some cases chloride of sodium or potassium, or chloride of lime may be added for the purpose of causing a readier precipitation. By the addition of solution of salts of lime produced by the lixiviation of "tank waste," a mixed precipitate of phosphate of alumina and sulphate of lime is obtained. —H. J.

Utilisation of Waste Calcium Chloride. C. T. Richardson. Eng. Pat. 10,418, July 21, 1884.

THE process, which is primarily designed to effect the utilisation of the calcium chloride produced as a waste product in the Weldon process, the ammonia-soda process, etc., consists in treating the purified solution with solution of sulphate of ammonia in the proportion requisite for the conversion of the whole of the calcium chloride into sulphate. The precipitated lime salt is then separated by filtration, and the ammonium chloride solution concentrated and crystallised in the usual manner.—H. J.

Improvements in making Granulated Crystalline Carbonate of Soda, and in Apparatus therefor. J. Mactear. Eng. Pat. 10,651, July 28, 1884.

THE invention relates to the manufacture of carbonate of soda (soda crystals) in a granulated crystalline form, and is an improvement upon the inventor's patent, No. 1714, of 1875. The process consists essentially in dissolving soda ash in water, and subjecting the solution during crystallisation to the combined action of cooling and scraping or agitation in a long shallow trough having a passage for cooling water beneath it, and provided with a number of scrapers fixed to a frame which receives longitudinal movements from a rotating shaft, and which is lifted during its return movement by bell-cranks operated on by a rotating cam.—H. J.

Improved Process for Obtaining or Recovering Manganese Oxide from Manganese Sulphate produced in obtaining Chlorine. J. Mactear. Eng. Pat. 10,813, July 31, 1884.

A SOLUTION of manganese sulphate is mixed with sufficient magnesium chloride to be equivalent to the sulphate, and to any free sulphuric acid in the solution. The mixture is evaporated out of contact from air, whereupon hydrochloric acid is copiously evolved, and may be condensed and utilised. In this way there is formed a mixture of manganese oxide and magnesium sulphate, from which the latter can be removed by washing with water. The manganese oxide can be subsequently raised to a state of higher oxidation for use in obtaining chlorine. The magnesium sulphate may be crystallised, and sold as such, or it may be reconverted into magnesium chloride for use again in the process.
—S. H.

Improvements in the Manufacture of Chlorine and Hydrochloric Acid. W. Weldon. Eng. Pat. 11,035, August 7, 1884.

THIS invention consists in heating solid hydrated magnesium chloride to a low temperature, so as to drive off a large portion of its water without driving off more than a small part of its chlorine. After having been partially dehydrated, the solid magnesium chloride is intimately mixed with magnesia and the mixture heated in a current of air. The chlorine is thereby driven off, partly in the free state and partly as hydrochloric acid. Instead of partially dehydrating the magnesium chloride before adding magnesia, the latter may be intimately mixed previously. In this case, if it be desired to obtain as much as possible of the chlorine in the free state, the mixture should at first be dehydrated by heating it at a low temperature, and should be then heated to a higher temperature in a current of air.—S. H.

Improvements in Manufacturing Chlorine from Hydrochloric Acid. W. Weldon. Eng. Pat. 11,036, August 7, 1884.

THE invention relates to neutralising with magnesia the hydrochloric acid from which it is desired to manufacture chlorine, and then treating the magnesium chloride so obtained for the separation of free chlorine from it. This is best done by evaporating the solution of magnesium chloride and adding magnesia to it. The solid magnesium oxychloride thus obtained is heated to a low temperature to drive off a portion of its water, and then to a high temperature in a current of air.
—S. H.

Obtaining Large-grained Salt. Brandes, Lippe. Ger. Pat. 31,781, August 26, 1884.

IN order to obtain a larger amount than hitherto of coarse-grained salt from brine, the latter is drawn off as soon as the coarse grains have completely formed, and worked for fine-grained salt in a second pan. Hitherto a portion of the large-grained salt has been allowed to remain in the pans, to be collected subsequently as a second-quality product.—W. D. B.

Improvements in Packages for containing Caustic Soda. J. Clare. Eng. Pat. 12,159, September 9, 1884.

THE improvement consists in the method of closing the orifice in the head of the caustic-soda drum by means of a lid with folded edges, so arranged as to slide within the edges of the orifice, also folded to correspond.
—H. J.

Improvements in the Utilisation of Alkali Waste from the Leblanc Process in the Manufacture of Carbonate of Soda with Production of Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 381, January 12, 1885.

THE object of this invention is to dispense with the use of lime for the liberation of ammonia from ammonium chloride in the ammonia-soda process, by employing alkali waste from the Leblanc process for this purpose, and also to produce sulphuretted hydrogen in a condition available for the manufacture of sulphur or its compounds. A mixture of alkali waste is heated with a solution of ammonium chloride in a closed vessel, when ammonium sulphide will be given off with the steam. This vapour is absorbed in water, and employed for the manufacture of carbonate of soda. by being conducted into a solution of sodium chloride, together with carbonic dioxide, in the same manner as free ammonia is employed in the ordinary manufacture of carbonate of soda by the ammonia process. Ultimately the sulphur which passes into the absorbing plant is liberated in combination with hydrogen, and may, after washing with an acid solution to absorb any trace of ammonia, be burnt or dealt with by any of the known methods.
—S. H.

Improvements in the Manufacture of Chromates and Bichromates. J. J. Hood. Eng. Pat. 3895, March 26, 1885.

THE chrome ore is first heated with potassium salts, and with or without lime, in the usual manner, lixiviated, and the resulting potassium chromate solution concentrated.

In order to produce sodium chromates, the above-described solution is treated with sufficient sulphate of soda to convert all the potassium and calcium salts present into sulphates, and the mixture concentrated, when the potassium sulphate crystallises out, and may be used for decomposing a fresh quantity of ore; the saturated solution of sodium chromate is then treated with the quantity of sulphuric acid necessary to combine with half the sodium present, and the sodium sulphate separated by crystallisation. The solution of sodium bichromate is then further concentrated and crystallised, or evaporated to dryness and fused.

To prepare the ammonium chromates, a hot, strong solution of ammonium sulphate is added to a hot, strong solution of potassium chromate, and the whole allowed to cool, when the bulk of the potassium sulphate formed crystallises out. The residual liquid, which still contains some potassic sulphate, may be used for making either ammonium chromate or bichromate; for the first salt, the liquid is evaporated at a gentle heat, with addition of ammonium hydrate if necessary; during the concentration the potassium sulphate crystallises out and is removed, and the ammonium chromate is eventually allowed to crystallise. To form ammonium bichromate, the liquid is simply boiled down, the potassic sulphate taken out as it separates, and the solution crystallised; the ammonia gas given off during the operation being collected by suitable means.

Or the ammonium salts are prepared from sodium chromate, and ammonium sulphate or chloride, with addition of hydrochloric or sulphuric acid in sufficient quantity to form sodium bichromate, whereby losses of ammonia are avoided. Other chromates and bichromates may be prepared from sodium chromate.—H. J.

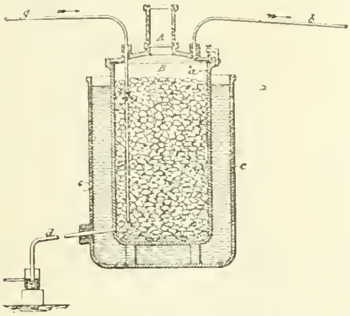
Improvements in Apparatus for the Production of Sulphuric Acid. William Spence. From J. Thyss, of Baku, Russia. Eng. Pat. 9317, June 23, 1884.

THE apparatus under this invention is intended to increase the production of sulphuric-acid chambers, and consists in the adaptation to such chambers of one or more columns of lead, which support leaden frames and sheets of lead pierced with holes alternately. Sulphurous acid, nitrous gases, and steam pass through the holes of the plates and impinge on the parts not perforated, whereby a multiplied contact is brought about which effects a better oxidation of the sulphurous acid.—S. H.

Improvements in the Manufacture of Anhydrous Sulphuric Acid. Henry Edward Newton. From A. Nobel and G. Fehrenbach, Paris. Eng. Pat. 10,860, August 1, 1884.

AN air-tight cylinder of acid-proof material *a* is filled with fragments of glacial phosphoric acid, and sur-

rounded with a sand-bath *c*, which permits of its being heated to a high temperature. On passing vapours of monohydrated or highly concentrated sulphuric acid through the pipe *g*, sulphuric anhydride is formed, and distils over through *b*, whilst at the same time the glacial phosphoric acid absorbs the water contained in

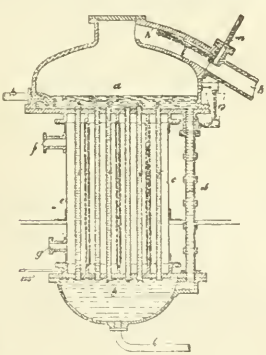


the sulphuric acid, as well as a certain quantity of sulphuric acid, liquefies and flows off through *d*. From time to time a fresh supply of phosphoric acid is introduced through A. The residual liquid phosphoric acid, containing water and sulphuric acid, can be recovered by distilling off the sulphuric acid after adding some more water.—S. H.

Improvements in Apparatus for Concentrating Sulphuric Acid. P. Jensen, London. From A. Kux. Eng. Pat. 8803, June 10, 1884.

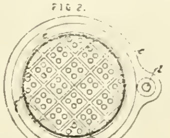
THIS apparatus (see Figs. 1 and 2) consists of an upper dome-shaped part *a* connected with a lower

FIG 1.



dome-shaped part *b*, by a system of tubes, through which the dilute acid circulates. The tube sys-

FIG 2.



tem is enclosed in a cylinder, through which steam is passed by the inlet *f* and outlet *g*. It is a special feature of apparatus constructed according to this invention that the steam does not pass through lead pipes, but outwardly surrounds a pipe system, through which the acid circulates. If a pipe becomes leaky, it can be stopped with a leaden plug; if it collapses, the apparatus still continues to work. The dilute sulphuric acid enters at *h*, and is heated in the tubes. Aqueous vapour passes away at *k*, a spray *l* fixing any acid mechanically carried over. A tube *d*, which is not heated, assists the circulation of the acid between *a* and *b*. The concentrated acid is drawn off at *i*. This apparatus is especially suitable for the concentration of the dilute acid from vacuum ice-making machines.—W. D. B.

An Improved Method and Apparatus for Recovering the Nitrous Products in the Manufacture of Sulphuric Acid. C. D. Abel. From the Société Anonyme de Javel, Paris. Eng. Pat. 10,871, August 1, 1884.

THE recovery of nitrous compounds in the manufacture of sulphuric acid by the employment of Gay-Lussac towers is unsatisfactory, because by these means there is not effected that intimate mixture of the gases which is necessary for the formation of nitrous acid that is absorbed by sulphuric acid. This invention relates to a method for effecting the required intimate mixture without resistance to the flow of the fluids. At the top of a tower, lined with lead, are placed several sets of apparatus delivering showers of concentrated sulphuric acid about 60° B., which descend on to a stratum of coke about a foot deep laid on a grating raised about a yard above the bottom of the tower. The gas enters under this grating, rises up through the showers of sulphuric acid, and is led by a pipe from the top down to the bottom of the Gay-Lussac tower.—S. H.

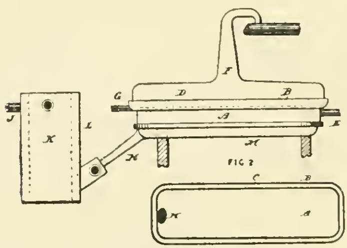
Apparatus for Concentrating Sulphuric Acid. A. J. Boult, London. From M. Willett, U.S.A. Eng. Pat. 9362, June 24, 1884.

THE objects of this invention are to allow the acid to be rapidly and easily heated, to condense the vapours evolved at some distance away from the surface of the acid—thus obviating any cooling action at the surface of the acid,—to render possible the employment of light, and rolled instead of hammered platinum, and to reduce fuel consumption, size of apparatus, and loss of platinum. The boilers consist of platinum tubes about three feet in length and six inches in diameter, preferably arranged in a series at descending levels above an inclined furnace shaft. The tubes are supported by a number of iron plates set vertically at right angles to the length, and shaped to conform to the curve, of the boilers. The ends of the boilers project beyond the outside supporting plates, so that the solder-jointing of the ends is not exposed to the action of the fire. Plates of iron or other suitable material running lengthwise between the tubes prevent the portion of the boilers above the therein-contained acid from coming in contact with the flames or hot gases from the furnace. The boilers have gas openings at their tops in the centre, by which the vapours are conveyed to water arms, and thence to condensers. The connection of the boilers in series is effected by platinum tubes at alternate ends, each containing a slip-joint, this arrangement being rendered possible by the gradation of levels. These connecting tubes are so arranged that the first or highest boiler containing the weakest acid, and exposed to the least degree of heat, has a film of liquid not more than an inch and a-half deep; whilst the last or lowest boiler holding the strongest acid, and exposed to the greatest heat, from its position in front of the furnace, contains acid to the depth of two inches and a-half. The position of the connecting tubes is such that the acid from the surface of an upper or preceding boiler is carried to the bottom of that next below it. The capacity of production is stated to be from eighteen to twenty-two pounds per square inch, the loss of platinum six-tenths of a milligram per ton of oil of vitriol obtained.—W. D. B.

Improvements in Stills for Concentrating Sulphuric Acid. C. Bartsch. Eng. Pat. 6127, May 19, 1885.

A STILL for concentrating sulphuric acid which may be readily opened for inspection, and shall be less liable to fouling than the ordinary platinum still in use, is the subject of this invention. A in Fig. 1 is a trough of platinum, semi-circular in cross-section, and B is a flange secured to A near its top, and extending around its periphery, thus leaving a gutter C. D is a cover which rests in the gutter; E is the inlet pipe for the acid, and is placed near the top; F is an outlet for escaping fumes; G is an overflow pipe; H is the main outlet, leading into an equalising jar, whence the acid flows into convenient receptacles. The equalising jar consists of an inner and outer jar, between which a stream of cold water is passed. It is so placed that its outlet shall be level with the height at which the acid is desired to be kept in the still.

FIG. 1.



Before commencing to distil, the gutter C is filled with any liquid so as to form a hydraulic lute, and the equalising jar is filled with acid up to the level of its outlet. The acid to be concentrated is then allowed to flow slowly into the still through E. The main outlet is connected with the still at the point where the end-rise commences from the bottom, and thus will carry off acid from the very lowest portion of the still, whereby only that of the greatest specific gravity and consequent concentration flows off. The flow of the acid at the bottom outlet also carries off into equalising jar deposits of lead and iron sulphide contained in the acid and precipitated in the course of concentration, which would otherwise burn fast to the bottom of the still, and crack the bottom, owing to unequal expansion.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Remarks on the Calculation of Mixings for the Manufacture of Glass. E. Tscheuschenr. Dingl. Polyt. J. **256**, 75.

NOTWITHSTANDING the many publications which appeared in the last decade on the chemical constitution and composition of glass, we are still in want of a practical method which allows of easily calculating the mixtures of raw materials for glass making. Although we know that many kinds of glass consist of a double compound of an alkali trisilicate and earth trisilicate, the proportion of both remains still to be settled. According to Benrath, this proportion should only vary from 1 : 1 to 5 : 7 for the best glasses, but R. Weber has lately shown that considerably greater variations may occur without detriment to the quality of the glass. The author has attempted to find out a relation between alkali, earth and silica for the different kinds of glass. If in the analysis of any glass xAO* expresses the alkali, yEO* the earth, and $z SiO_2$ the silica, all in equivalents, the composition of glass will be represented by the formula $x\mathrm{AO} + y\mathrm{EO} + z\mathrm{SiO_2}$, where x, y, z may be figures variable between certain limits, according to the quality of the glass. For the normal composition of glass, these coefficients would have the value $x = y = 1$; $z = 3\ (x + y) = 6$. But the formula $z = 3\ (x + y)$ would only be right if $x = y$—that is to say, if the glass contains equal equivalents of alkalis and earths, the amount of silica should be six times as much. This formula is now compared with some analyses of glass, published by R. Weber, which has been found in practice to possess the physical qualities required. In these analyses there was—

x	y	z	$3(x+y)$	$\left(\frac{x^2}{y} + y\right)$
0·6	1	4·0	4·8	4·1
0·6	1	4·2	4·8	4·1
8·88	1	5·3	5·64	4·8
0·9	1	5·3	5·7	5·4
0·9	1	5·2	5·7	5·4
0·6	1	4·4	4·8	4·1
0·6	1	3·8	4·8	4·1
2·0	1	12·5	9·0	15·0
1·5	1	9·6	7·5	9·75
1·5	1	8·8	7·5	9·75
0·85	1	5·2	5·55	5·20
0·33	1	3·5	3·99	3·33

The first three columns represent the equivalent of alkali, earth and silica really found in the samples; the fourth column shows the figures which should have been expected if the amount of silica corresponded with $3(x + y)$, whereas the fifth column is calculated from another formula which was substituted for $3(x + y.)$ As already mentioned above, z could only be equal to $3(x + y)$ if x be equal to y, but this was not the case in the samples tested. We also see that z is lower than $3(x + y)$ if x be smaller than 1, and *vice versâ*. The substituted formula $3\left(\frac{x^2}{y} + y\right)$ agrees much more closely to the results found by analysis, and we should now write our normal formula for the composition of glass, $x\mathrm{AO} + y\mathrm{EO} + 3\left(\frac{x^2}{y} + y\right)\mathrm{SiO_2}$. We can further conclude from the analyses that if $y = 1$, x may vary from 0·6 to 1·0 for sheet-glass, from 1·5 to 2·0 for Bohemian flint-glass, and from 0·8 to 1·5 for white bottle-glass. Assuming these variations, we obtain the following formulas for the composition of sheet-glass (R = K or Na).

1. $(0{\cdot}6R_2O + 1.CaO)4{\cdot}1SiO_2$
2. $(0{\cdot}7R_2O + 1.CaO)4{\cdot}5SiO_2$
3. $(0{\cdot}8R_2O + 1.CaO)4{\cdot}9SiO_2$
4. $(0{\cdot}9R_2O + 1.CaO)5{\cdot}4SiO_2$
5. $(1{\cdot}0R_2O + 1.CaO)6{\cdot}0SiO_2$

From these formulæ we can calculate the following percentage compositions for the two kinds of sheet-glass:—

Potash-Lime Glass.	Soda-Lime Glass.
1*a*. 0·6×47·1 = 28·26 = 15·7 K_2O	1*b*. 0·6×31 = 18·6 = 11·0 Na_2O
1·0×28·0 = 28·0 = 15·6 CaO	1·0×28 = 28·0 = 16·5 CaO
4·1×30·0 = 123·0 = 68·7 SiO_2	4·1×30 = 123·0 = 72·5 SiO_2
179·26 100·0	169·6 100·0
2*a*. 0·7×47·1 = 32·97 = 16·8 K_2O	2*b*. 0·7×31 = 21·7 = 11·7 Na_2O
1·0×28·0 = 28·00 = 14·3 CaO	1·0×28 = 28·0 = 15·2 CaO
4·5×30·0 = 135·00 = 68·9 SiO_2	4·5×30 = 135·0 = 73·1 SiO_2
195 97 100·0	184·7 100·0
3*a*. 0·8×47·1 = 37·68 = 17·7 K_2O	3*b*. 0·8×31 = 24·8 = 12·4 Na_2O
1·0×28·0 = 28·00 = 13·2 CaO	1·0×28 = 28·0 = 14·0 CaO
4·9×30·0 = 147·00 = 69·1 SiO_2	4·9×30 = 147·0 = 73·6 SiO_2
212·68 100·00	199·8 100·0
4*a*. 0·9×47·1 = 42·39 = 18·2 K_2O	4*b*. 0·9×31 = 27·9 = 12·8 Na_2O
1·0×28·0 = 28·00 = 12·1 CaO	1·0×28 = 26·0 = 12·8 CaO
5·4×30·0 = 162·00 = 69·7 SiO_2	5·4×30 = 162·0 = 74·4 SiO_2
232·39 100·00	217·9 100·0
5*a*. 1·0×47·1 = 47·1 = 18·4 K_2O	5*b*. 1·0×31 = 31·0 = 13·0 Na_2O
1·0×28·0 = 28·0 = 11·0 CaO	1·0×28 = 28·0 = 11·7 CaO
6·0×30·0 = 180·0 = 70·6 SiO_2	6·0×30 = 180·0 = 75·3 SiO_2
255·1 100·00	239·0 100·0

We will now illustrate the application of these formulæ for the production of sheet-glass of medium

* AO = alkali oxide; EO = earth oxide.

fusibility. Supposing there are the following raw materials :—

Nievelstein sand of 99% SiO_2
Ammonia soda ash of 98% CO_3Na_2(57·3% Na_2O)
Refined salt cake of 96% SO_4Na_2(42% Na_2O)
Ground Calc-spar of 97% $CaCO_3$(54·3% CaO)

According to formula 4*b*, we should have to take for a suitable mixing—

(12·8 × 100) : 57·3 = 22·3kg. soda ash
(12·8 × 100) : 54·3 = 23·6kg. calc-spar
(74·4 × 100) : 99 = 74·2kg. sand ;

or in using salt cake, (12·8 × 100) : 42 = 30·5kg. salt cake.

Just in the same manner we can apply the other formulas for the production of glass, more or less fusible, just as required. The mixtures for cast plate-glass formerly contained far more alkali than they do at present. Whereas Henrivaux's analysis of an old plate-glass from St. Gobain showed

SiO_2	77·1%
CaO	6·0
Na_2O	16·2
Fe_2O_3 and Al_2O_3	0·7

corresponding to the proportion of equivalents 12·2 : 1·0 : 2·5, new plate-glasses have the following composition :—

Or, expressed in equivalents of silica, lead oxide and potash—

3·5 : 1·0 : 0·33 ; 4·7 : 1·0 : 0·8 ; 5·1 : 1·0 : 0·7 ; 6·5 : 1·0 : 1·0

whereas the normal formula would require

3·3 : 1·0 : 0·3 ; 4·9 : 1·0 : 0·8 ; 1·47 : 1·0 : 0·7 ; 6·0 : 1·0 : 1·0

There are also published analyses of flint-glass containing more and less silica than required by the normal formula. This shows that the easy fusibility of lead silicate allows of employing more silica than corresponding with the formula. But if less silica be employed, the glass will not be very durable. Indeed, it appears that these glasses are only specially prepared for optical purposes where a great refractive power is the principal aim. For cheapness' sake, a portion of lead oxide is often replaced by lime or baryta, or a mixture of either, and in this case the amount of silica agrees with our normal formula, as shown by Nehse and Schür's analyses of Mastrich half-crystal glass :—

SiO_2	61·9	65·5	57·5
PbO	16·0	16·0	25·4
CaO	4·5	9·1	4·1
BaO	6·3	—	—
K_2O	11·3	—	11·9
Na_2O	—	9·4	1·1

$SiO_2 : \underbrace{PbO + CaO + BaO}$: Alkali—5·1 : 1 : 0·6 ; 4·7 : 1 : 0·7 ; 5·0 : 1 : 0·7

Calculated on our formula— 4·1 : 1 : 0·6 ; 4·5 : 1 : 0·7 ; 4·5 : 1 : 0·7

	From St. Gobain (Henrivaux).	From Montluçon (Henrivaux).	From Germany (Henrivaux).	From St. Gobain (Pelouze).	From Aix-la-Chapelle (Jaeckel).
SiO_2	72·1	69·3	70·27	72·1	72·31
CaO	15·7	15·8	15·86	15·5	14·96
Na_2O	12·2	13·4	13·66	12·1	11·42
Or expressed in equivalents	4·3 : 1 : 0·7	4·1 : 1 : 0·6	4·1 : 1 . 0·6	4·3 : 1 : 0·6	4·5 : 1 : 0·7

These very well agree with our normal formula, which would require thus :—

4·17 : 1 : 0·7 ; 4·08 : 1 : 0·6 ; 4·08 : 1 : 0·6 ; 4·08 : 1 : 0·6 ; 4·17 : 1 : 0·7

For white bottle glass, the proportion of the equivalents between lime and alkali should lie between 1 : 0·8 and 1 : 1·6, corresponding with the following percentage composition :—

	Soda-Glass.	Potash-Glass.
SiO_2	from 74 to 79·5	from 69·5 to 74·8
CaO	„ 14 „ 7·6	„ 13·0 „ 7·2
Na_2O	„ 12 „ 12·9	„ 17·5 „ 18·0

whereas for crystal glass (grinding glass), the proportion of lime and alkali should lie between 1 and 2, or, expressed in percentage—

SiO_2	78·6%
CaO	5·0
Alkali	16·4

Numerous analyses of good flint-glass also prove the applicability of our normal formula, thus :—

Of late years the demand for a glass combining cheapness and durability caused glass-makers to produce glass containing as much silica as possible. The amount of lead oxide had thus to be reduced, and this was replaced by potash, in order to guard against any appearance of a yellowish colour. But the quality grows inferior at the same time, a decrease of lead being accompanied by loss of weight, brilliancy, refractive and diversive power. In using 90% pearl-ash, normal mixtures are thus :—

Sand	100	100	100	100
Red lead	108	81	74	58
Carb. of potash	24	43	35	40

or for hard crystal-glass—

Sand	100	100	100	100
Red lead	73	63	56	48
Carb. of potash	24	17	15	26

or for soft optical glasses—

Sand	100	100
Red lead	130	200
Carb. of potash	26	14

	Flint-Glass (Weber).	French Crystal (Benrath).	English Flint-Glass (Berthier).	English Flint-Glass (Faraday).
SiO_2	45·42	48·1	51·4	55·13
PbO	47·06	38·0	37·4	31·20
CaO	—	0·6	—	—
K_2O	6·8	12·5	9·1	13·51
$Fe_2O_3 + Al_2O_3$	0·82	0·5	2·0	—
MgO	0·36	—	—	—
	100·46	99·7	100·2	99·81

Our normal formula is not applicable for the composition of green bottle-glass. Cheapness is here the first consideration, and therefore expensive alkalis must only be very economically used. Green bottle-glass can, indeed, be considered as a lime silicate, often containing alumina and magnesia silicate. On account of the absence of an alkali, the composition approaches that of a bisilicate. A higher amount of silicate cannot be attained without making the glass so difficult to fuse as to make it quite impossible to work it in our furnaces. As a matter of fact, the glass-maker finds it often necessary to add a little iron as a flux to avoid devitrification. French bottle-glass, of latest make, had the following composition, according to Henrivaux :—

	Cognac.	Bordeaux.	Champagne.
SiO_2	62·54	61·75	61·90
Al_2O_3	4·42	7·10	4·44
Fe_2O_3	1·34	2·70	1·85
CaO	20·47	19·60	17·95
MgO	5·41	4·55	6·18
Na_2O	4·73	4·10	6·16
MnO	4·73	0·11	6·16
K_2O	0·94	0·11	1·13
SO_4H_2	0·10	0·09	0·17
	99·95	100·00	99·98

Proportion of equivalents—

2·0 : 1·0 : 0·1   2·0 : 1·0 : 0·1   2·0 : 1·0 : 0·2

Supposing the following raw materials have to be used for bottle-glass making :—

Gneiss, composed thus—

SiO_2	64·17%
Al_2O_3	13·87
FeO	6·40
CaO	2·74
MgO	2.21
K_2O+Na_2O	7·63
H_2O	1·01
	98·03

Sand of 90% SiO_2; 5% Fe_2O_3 and 5% Al_2O_3, and limestone of 91% $CaCO_3$; 5% SiO_2 and 4% Al_2O_3 + Fe_2O_3.

a suitable mixing would be 100 parts gneiss, 70 parts limestone, and 60 parts sand.

Parts	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O+Na_2O	Tl.
100 gneiss contain ..	64·17	13·87	6·10	2·74	2·21	7·63	97·02
70 limestone ,, ..	3·00	2·40	—	35·70	—	—	41·10
60 sand ,, ..	54·00	3·00	3·00	—	—	—	60·00
	121·17	19·27	9·40	38·41	2·21	7·63	198·12

The bottle-glass obtained would therefore have the following composition—

	%		Equivalents.	
SiO_2	61·2			=2·04
Al_2O_3	9·6	=	0·18	
Fe_2O_3	4·7	=	0·11	=1·03
CaO	19·4	=	0·69	
MgO	1·1	=	0·05	
Alkali	4·0			=0·10
	100·0			

which corresponds well with Henrivaux's analyses of French Cognac and Bordeaux bottle-glass.

We may therefore say that whereas in the composition of green bottle-glass the formation of a bisilicate is all that can be aimed at, for all other kinds of glass with x equivalents of alkali and y equivalents of earths we can arrive at the amount of silica z in equivalents by applying the formula $z=3\left(\frac{x^2}{y} + y\right)$.—S. H.

Contributions to a Knowledge of Opal or Cryolite Glass. C. Weinreb. Dingl. Polyt. J. **256**, 361.

Oxide of tin, which doubtless formed a difficultly-fusible tin enamel, was first employed for the above variety of glass; this was replaced later on by calcium phosphate from the ashes of bone and guano—the majority of mineral phosphates such as phosphorites and apatite are too rich in iron for the purpose, the product being known as bone-glass. In 1860, in North America, an opal glass was prepared by the use of cryolite, $Al_2F_6,6NaF$, and since that date this material has been employed almost exclusively. Seeing that the price of cryolite has risen greatly, a substitute for cryolite is desirable. It is then first necessary to determine on what circumstances or materials the production of milk-glass depends. In 1869 Benrath examined American cryolite glass, and finding no fluorine, advanced the opinion that the opalisation was due to a separation of alumina, and designated this phenomenon "devitrification"; he also concluded that the whole of the fluorine had been volatilised as silicon fluoride. In the same year, a cryolite glass from the same source was examined by Williams, who found that it contained fluorine, and ascribed the opalization to a formation of silicofluoride of sodium, which dissolved in the molten glass, but separated on cooling. The statements of these two observers, as to the presence of fluorine, being so contradictory, the author analysed an Austrian cryolite glass, with the following results :—SiO_2, 78·00; Al_2O_3, 3·12; Fe_2O_3, trace; MnO, trace; CaO, 3·87; Na_2O, 9·46; K_2O, 4·35; F, 3·77; total, 102·57; less O corresponding to F, 1·59 = 100·98. From these numbers the proportions of the materials of the charge may be calculated with approximation to have been—SiO_2, 100; Al_2F_6, 6NaF, 15·91; Na_2CO_3, 8·13; K_2CO, 7·91; $CaCO_3$, 8·55. The amount of alumina found is a measure of the cryolite added, and from the proportions respectively which alumina bears to fluorine in cryolite and in the glass, it appears that during the melting, 4·11 parts of fluorine per 100 of SiO_2 are volatilised as a silicon fluoride. With a view of determining whether the formation of milk-glass is due to (1) alumina, (2) fluorine, or (3) alumina in conjunction with fluorine, the author has made synthetical experiments recorded in detail. The results show conclusively that only in conjunction with fluorine has alumina the power of causing "devitrification," this depending, apparently, upon the formation of aluminium fluoride which dissolves in the molten mass, but separates out in a most minute state of subdivision on cooling. If milk-glass manufacturers desire to dispense with the use of cryolite, recourse must be had to materials rich respectively in alumina and fluorine; in regard to the first there is little difficulty, as kaolin and felspar, free from iron, are readily obtained; in respect of the second, there is practically no choice but to employ fluor-spar, which it will be necessary to convert into an alkaline fluoride by fusion with sodium carbonate, since too much lime would be introduced into the glass were the fluor-spar directly added. The author has found by experiment that the yield of alkaline fluoride is much greater if an equal weight of silica be added before fusing with sodium carbonate. The melt is lixiviated, the solution consisting of alkaline fluoride and silicate is evaporated to dryness, and the dry residue added directly to the charge.—W. D. B.

X.—METALLURGY, MINING, Etc.

Progress in Metallurgy.

Zinc Extraction. Dingl. Polyt. J. **256**, 317-321.

L. Kleeman's modification of his condenser for zinc distillation is described; the object of the modification being to prevent escape of zinc vapours at the front of the furnace. (Ger. Pat. 28,596, December 14, 1883.)

Bessemerising Copper Ore and Matte. J. Garnier. Ger. Pat. 30,418, July 3, 1884.

A modified Bessemer converter for the above process. The lining is to be made either of siliceous material, or of materials which are not attacked by silica or bases, such as chrome iron ore, calcium sulphate, zinc silicate, calcium phosphate, etc. When an acid lining is employed, it is to be so thin that a layer of slag or matte may be chilled upon it by cooling the exterior of the vessel with an air or water-jacket.

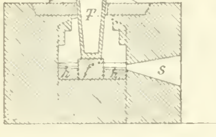
Furnace for Smelting or Fusing Metals. J. Quaglio, J. Pintsch and A. Lentz. Ger. Pat. 29,551, March 9, 1884. (See this Journal, vol. iii. p. 639.)

The arrangement consists of two shaft furnaces placed near together, and connected at the top and bottom by flues, in the latter of which are placed suitable valves to control the gaseous currents. The gases from one shaft are passed into the top of the other, and down through a mass of ignited fuel, and then into a gas-holder for distribution as required. The shafts are charged with fuel and ore, and the liquid products are removed in the usual way.

Fusion of Zinc Alloys. G. Selve. Ger. Pat. 29,535, June 21, 1883.

The patentee proposes the furnace shown in Figs. 1 and 2 for the preparation of zinc alloys. Crucibles T project through the roof of the furnace, and stand on refractory stands F. The crucible is somewhat smaller than the hole in the roof, so that the two are not in contact. The sole slopes on all sides towards the middle, so that when a crucible breaks, the spilt metal can be tapped off at S. In the preparation of brass, for example, after the requisite amount of copper is fused, the whole

Fig 1



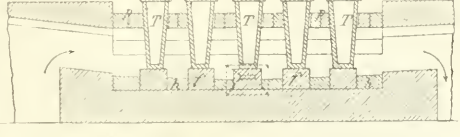


FIG. 2

of the zinc is quickly added, and so much scrap brass as will make the contents pasty. By this means cold layers of metal are formed in the upper part of the crucible. Since the crucibles project from the furnace this reduced temperature at the surface of the metal is easily maintained by the addition from time to time of scrap. By this means very little loss of zinc results. On drawing the crucible and stirring up the contents a uniform alloy is produced.—J. T.

Coating Iron and Steel with Copper and its Alloys. J. J. Taylor. Wolverhampton. Eng. Pat. 10,886, August 2, 1884.

THE articles are pickled as if for galvanising, and are then immersed in a hot solution of one pound borax to four gallons water. The articles are dried and immersed in the copper or copper alloy bath; the flux employed through which to enter the articles consists of borax. Common salt is added from time to time to thin this flux. The flux employed over the part of the bath where the articles are withdrawn after being coated, consists preferably of glass, though borax, alone or with glass, may be employed.—J. T.

Improvements in the Method of and in Apparatus for Extracting Gold and Silver from their Ores by Amalgamation. H. M. Whitehead, London. Eng. Pat. 11,701, August 27, 1884.

THE amalgamator consists of a series of air-tight chambers, each containing a vertical partition reaching from the top to within a short distance of the bottom, and having its lower edge toothed. One-half of one terminal chamber is connected with an exhauster, and the reverse half of the other terminal is in communication with an ore-feeding channel. A door is arranged at the lowest part of each chamber for the removal of amalgam, and a gauge glass is fitted to each pair of compartments. When required for use, mercury is poured into each chamber until the row of teeth is just covered, the exhaust is let on, and the ore fed in at the other end. The ore (dry or with water) is thus carried by suction beneath the division; and, therefore, through the mercury in each successive compartment until it passes away through the exhaust outlet. Flouring is to be prevented by the use of sodium amalgam or otherwise.—W. G. M.

An Improved Method of Extracting Copper, Nickel, Cobalt, Silver or Gold from their Ores. Lorentz Albert Groth, K.G.V., London. From C. G. Dahlerus, Denain, France. Eng. Pat. 5642, May 7, 1885.

THE ore is to be roasted, mixed with chloride of lime or similar substances, and dilute acid: the resulting solutions of the metals is then precipitated in the usual way. —W. G. M.

Improvements in Method of and Apparatus for Reducing Ores. J. K. Griffin, Brooklyn, U.S.A. Eng. Pat. 6124, May 19, 1885.

THE ore is fed through a hopper into a rotating distributor, having openings in its periphery for the discharge of the ore, and contained in an outer shell also revolving, but at a higher speed and in an opposite direction. The ore, thus fed in, becomes packed by the action of the centrifugal force against the inner wall of the shell until the accumulation has reached to the circumference of the distributor, then for the first time the pulverisation commences by the mutual attrition of the particles of ore. As fast as the substance is reduced to the required degree of fineness, the powder is carried away by currents of air introduced through channels in the distributor, and is collected in suitable receivers. The degree of fineness obtainable will vary (inversely) with the velocity of the air current. For certain ores it is preferable that the shell only rotate, the distributor remaining fixed. Experiment has shown that velocities of 150 to 200 revolutions per minute, in opposite directions, suffice to crush hard rock, such as quartz, to an impalpable powder in satisfactory quantities, and without injury to the machine, and without admixture of foreign substances.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Measurement of Frictions of Lubricating Oils. C. J. H. Woodbury. Bull. Mulhouse, 323, 1885.

THIS is a report by M. Scheurer-Kestner upon a paper bearing the above title, recently communicated to the Société Industrielle. The subject has been investigated by the dynamical method, and by means of an apparatus consisting essentially of a couple of discs with plane opposing surfaces, the lower of which is rotated by the direct application of power, the upper tending to be drawn into rotation by contact; this tendency is resisted and its quantity registered by means of a dynamometrical suspension. The oil to be tested is supplied continuously through a tube passing through the upper disc, which also contains an annular hollow through which a stream of water is made to circulate, when the experiments are to be made at constant temperatures. The quantitative expressions for the friction are obtained ultimately in terms of the dynamometer readings and the weight of the upper disc, and the results are given in three tables appended to the original paper. In the first are contained the results of varying the temperature from 40° to 100° F., and the downward pressure upon the upper disc from 1 to 40lb. per square inch. An inspection of the diagram, by which the numbers are graphically represented, shows that the force tending to rotate the upper disc does not increase proportionately to the pressure; this is due to the influence of the cohesion of the oil itself, in consequence of which it participates in the rotation. The second table gives the value of the coefficients of friction for the same series of experiments, calculated by means of an equation deduced from a

consideration of the special conditions of the apparatus, and of the phenomena to be investigated. In general terms, the introduction of the third lubricating substance, between the opposing surfaces, approximates the molecular problems involved to those of the flow of liquids from minute orifices. The coefficient of friction is seen from this table to diminish with increase of pressure, and of fluidity of the oil. The practical limit of fluidity is the necessity of preventing contact of the opposed surfaces. In the third table the effect of varying the temperature is shown by the numerical results obtained with a very fluid mineral oil, the pressure on the upper disc being kept constant at 33lb. per square inch. The maximum of useful effect was reached at 82° F. In conclusion, the author discusses the subject generally, showing to what extent purely scientific methods may be made to contribute to the elucidation of the very practical question of the value of lubricants.
—C. F. C.

Test of Mineral Lubricating Oils. P. Falke. Chem. Zeit. **9**, 906.

MINERAL lubricating oils are often adulterated by the addition of cheap oils. The following tests may serve for ascertaining their purity:—(1) Colour. The oil must be perfectly clear, and as light as possible. It should not be turbid, which may be caused by the presence of water or other substances. If the oil be turbid by water, it froths on heating, whereas a turbidity produced by solid matters, such as paraffin, disappears on warming, and reappears on cooling. The characteristic feature of all mineral oils is their blue fluorescence. (2) Smell. The smell must be as little perceptible as possible, and should not increase on warming the oil. It mostly smells like petroleum. (3) Behaviour on shaking with water. If three parts of oil be shaken with one part of water in a test tube, warmed, and allowed to stand in a water-bath for some time, no emulsion must appear between water and oil, but the latter should stand clear above the water, which should opalesce only very faintly, and be perfectly neutral. (4) Behaviour to caustic soda. The oil should not be attacked by a caustic lye of 1·40 sp. gr., neither in the cold nor on warming. Saponification is a certain evidence of the presence of animal or vegetable fat. (5) Behaviour to sulphuric acid. On mixing the oil with sulphuric acid of 1·60 sp. gr. it must not be coloured brown, but yellow at the most; otherwise resins have not been carefully removed. (6) Behaviour to nitric acid. On mixing oil with nitric acid of 1·45 sp. gr. a rise of temperature takes place, which should not exceed a certain limit. (7) Specific gravity. Although the specific gravity of oils suitable for lubricating purposes varies from 0·875 to 0·950, only a very small latitude (0·003 at the most) is permitted in contracts. It is invariably taken at 15° C. (8) Behaviour on exposure to the air and heat. Spread in a thin layer and exposed to the air for some time, its consistency must not change, nor should it become acid on being heated continuously above 150°. Heated in open vessels it should not give off combustible vapours, except at a high temperature, which is usually specified in contracts. Its flashing point should be ascertained in Abel's apparatus. (9) Behaviour at a low temperature. It should bear a low temperature without losing its lubricating power, nor should it become solid even at a very great cold, but it should rather assume the appearance of an ointment. (10) Test for consistency. This determination is most important. The velocity of efflux of pure rape-seed oil is taken as a standard, and that of the mineral oil compared with it. 100cc. of the sample are allowed to flow out of a burette with tap, while the time which is required is noted down. In conclusion, the author urges the desirability of having a uniform mode of testing.—S. H.

An Improved Process for the Extraction of Oil and the Production of Meal from Flax and other Seeds. H. H. Lake. From C. G. B. Casero, of St. Etienne, France. Eng. Pat. 11,403, August 18, 1884,

INSTEAD of, as usual, heating and then pressing the whole bulk of the linseed, the patentee reduces it to coarse powder, and separates the meal by sifting into two parts about equal in weight. The part which goes through the sifters contains nearly the whole of the oil, which may be thus expressed without torrefaction. A purer oil is the result, and there is far less tendency to form an emulsion, as the mucilage remains in the portions which do not go through the sifter, which also thus form a novel linseed meal.—W. L. C.

A New Method of and Apparatus for Making Emulsions for different Purposes. C. J. P. de Laval. Eng. Pat. 12,562, September 18, 1884.

EMULSIONS of fats and oils, both for food purposes and as lubricants, are prepared by forcing liquid fat or oil, under high pressure, into liquids at lower pressure, in finely-divided streams, through minute apertures. The apparatus consists essentially of two reservoirs and a force-pump, the outlet of which is a heavily-loaded valve, adjustable by a fine-threaded screw. Drawings are given.—W. L. C.

Improvements in Apparatus for Lard Refining, Cooling, and Filling. C. F. Hodges and W. Christy. Eng. Pat. 12,720, September 23, 1884.

THE apparatus, which is figured, consists of (1) a refining tank provided with a steam-jacket and mechanical stirrers; (2) a cooling tank provided with dashers or stirrers, and circulating pipes for hot water or steam; (3) filling apparatus with clips and nozzles, mechanically operated.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

The Darkening of Oil Colours. R. Kayser. "Mittheilungen des bayerischen Gewerbemuseums," 1885, p. 21.

THE author's observations confirm the statement that if a varnish boiled with litharge be rubbed up with cinnabar, a formation of sulphide of lead gradually results. In oil painting only varnish prepared with borate of manganese should be employed, for the author ascribes the darkening of oil-colours to this gradual formation of lead sulphide.—W. D. B.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Adulteration of Leather. R. Kayser. Chem. Zeit. **56**, 1001.

STARCH sugar is added frequently to increase the weight, as leather is eight or ten times as dear as this adulterant, and the sophistication cannot be detected without chemical investigation. On examination of different samples of leather, the author finds grape-sugar present in quantities varying from 2·7 to 7·6 per cent.—S. R.

XV.—SUGAR, GUMS, STARCHES, Etc.

Sugar Beet Farming. Dingl. Polyt. J. **256**, 374.

WREDE places the cost of sugar beet growing in the province of Hanover at 2·5 marks per double centner, inclusive of leaves and cuttings. How much of the cost of production is to be subtracted on account of these two last items is doubtful.

Lach shows that beets grown in the shade are inferior to those in the open.

By cultivation experiments on nine different estates, Maercker has found that on an average the highest sugar contents per beet—viz., 14·9 percent.—was obtained with Dippe's Improved White, but the best total yield of sugar with Klein-Wanzlebener Original crossed with Vilmorin Klein-Wanzlebener.

The importance of cultivating varieties as rich in sugar as possible is shown by the following results:—

	Variety rich in Sugar.	Variety poor in Sugar.	Difference.
Yield per morgen....	18tcentnr.	192centnr.	−8
Sugar in the beet....	14·3	12·5	−+1·8
Degree Brix	18·5	16·8	−+1·7
Sugar in the juice ..	15·9	14·0	−+1·9
Quotient	85·9	83·3	−+2·6
Sugar per morgen ..	26·31	21·0	−+2·31

—W. D. B.

Some Reactions of the Glucosides Helicin and Gluco-vanillin. F. Tiemann and A. Kees. Ber. **18**, 1657-1665.

In studying the formation of such glucosides as these in the plant, the authors endeavour to obtain light as to the physiological processes in the vegetable organism giving rise to them. Therefore a trustworthy test for these glucosides would be of extreme value. The authors claim the introduction of the phenylhydrazine and hydroxylamine derivatives for this purpose, which give characteristic reactions. They are prepared with great facility; the former derivatives by gently heating either helicin or glucovanillin with phenylhydrazine hydrochloride—the new hydrazines separate on cooling; the latter derivatives by heating in molecular proportions a slightly alkaline alcoholic solution of either of the glucosides with hydroxylamine. When the reaction is complete the mixture is neutralised, evaporated to dryness, and extracted with absolute alcohol. *Helicin phenylhydrazine*, $C_6H_4(CH.N_2HC_6H_5)(OC_6H_{11}O_5)[1:2]$, is soluble in alcohol, ether and hot water, almost insoluble in cold water, and insoluble in benzene. It is deposited from its aqueous solutions in white, scarcely crystalline masses, which turn brown without apparent decomposition when dried in the air. The dry substance melts at 187°. It does not reduce Fehling solution. The hot aqueous solution is yellow, by prolonged boiling the colour becomes paler, and the substance undergoes partial decomposition. Emulsion resolves it into the hydrazine of salicyl aldehyde, identical with that of Fischer (*Ber.* 17, 575) and Rössing (*Ibid.* 3004), and glucose identified by the Fehling- and by Fischer's hydrazine-reaction. *Gluco-vanillin phenylhydrazine*,

$$C_6H_3(CH.N_2HC_6H_5)(OCH_3)(OC_6H_{11}O_5)[1:3:4],$$

crystallises from its solution in boiling water, is readily soluble in alcohol, sparingly in cold water, and almost insoluble in benzene and ether. It is coloured brown in the air, and when dry melts at 195°. It produces a green precipitate in, but does not reduce Fehling solution. With emulsion it yields glucose and *vanillin phenylhydrazine*, $C_6H_3(CH.N_2HC_6H_5)(OCH_3)(OH)[1:3:4]$, which forms greyish-white leaflets (m.p. 105°) with silver lustre, and when moist become discoloured in the air. The crystals are readily soluble in alcohol, ether, and benzene, but very sparingly in water and light petroleum. *Helicin aldoxim*, $C_6H_4(CH.NOH)(OC_6H_{11}O_5)[1:2]$, crystallises in fine white needles (m.p. 190°) with 1mol. H_2O, which loses at 100°. It is insoluble in ether, but slightly soluble in alcohol, moderately so in water, whilst it dissolves readily in both acids and alkalis, but is partially precipitated from concentrated acid solutions by ammonia. It gives no characteristic colour reaction with concentrated sulphuric acid. It is powerfully lævorotatory. Emulsion converts it into glucose and *salicyl aldoxim* (see Lach, *Ber.* 17, 1785). *Gluco-vanillin aldoxim*, $C_6H_3(CH.NOH)(OCH_3)OC_6H_{11}O_5)[1:3:4]$, forms light yellow needles (m.p. 152°) with 1mol. H_2O, which is driven off at 100°. It is less soluble in water and alcohol than helicin aldoxim, but behaves in a similar manner to that substance with the other reagents, and the polariscope. With emulsion it yields glucose and *vanillin aldoxim* (comp. Lach., *Ibid.* 1786). In all the above reactions the aldehyde group of the glucosides is attached, and the authors could not induce action between ether phenylhydrazine or hydroxylamine, and the glucose nucleus of these and many other glucosides —*e.g.*, salicin, coniferin, etc.; in this they resemble the kind of sugars termed by Scheibler "Biosen," which do not react until they are inverted.—D. A. L.

Constitution and some Properties of Raffinose. C. Scheibler. Ber. **18**, 1779-1786.

The author confirms the identity of raffinose with "plus-sugar" and "gossypose" (see this Journal, iv. 411). Loiseau found fifteen per cent. of water in raffinose, and attributed to it the composition indicated by the formula $C_{18}H_{32}O_{16}+5H_2O$. Ritthausen, on the other hand, found only 13·64 per cent. water in his sugar from cotton seed, and concluded it was $C_{12}H_{22}O_{11}+3H_2O$. These different results are due to the difficulty attached to drying raffinose; heated at 85° to 90° below its melting point, it loses only 13·64 per cent. of water; when it is heated higher, even at a little above 100°, it begins to caramelise, and becomes to a certain extent inverted; raffinose is hence much more susceptible to change than raw sugar, which does not caramelise under 160°. By drying this sugar, as far as possible (until the loss = 13% water), over sulphuric acid, and then in a water-bath the author is able to confirm Loiseau's view of the composition of raffinose. The author finds its specific rotation is $\frac{I}{D} = +103·9$ to 104, or $\frac{I}{\surd} = 114·6$. By treatment with acid at 17—18° C. its rotatory power diminished at first rapidly, later on slowly, and after ten days was constant at +52·3. At higher temperatures this change takes place quicker; at 60°, for example, the specific rotation is reduced to +53·2 in three hours, and to 46·7 in sixteen hours; the solution then becomes yellow, and the colour increases as the heating is continued. The author suggests that the rapid reduction in this rotation is due to inversion, whilst the slower decrease is perhaps the result of a subsequent change in the product of inversion. This point is being investigated with phenylhydrazine, and otherwise. From these properties of raffinose, and as it is found associated with a betain both in cotton seed (*loc. cit.*) and in beet, the author infers that it is present in the original beet. Its easy inversion and caramelising, and its high specific rotation, go far to explain the reduction in polarisation and partial inversion of beet-juice during the winter storage of roots in heaps. Roots of high rotatory power suffer much quicker and to a greater extent than other roots; these roots are supposed to be poor in juice because they yield less sugar than their rotatory power indicates. It is now evident that this supposition is not correct, but, in fact, these roots contain a large percentage of raffinose, which would account for the high rotatory power, for the bad-keeping properties, etc. The behaviour of many sugar residues suggests the presence of raffinose. The identity of *raffinose* and melitose is not yet confirmed. Raffinose containing C_{18} would be classed, according to the author, as a "Trios" sugar.—D. A. L.

XVI.—BREWING, WINES, SPIRITS, Etc.

Extracts from the Report of the Meeting of the Brewery Institute in Berlin. Chem. Zeit. **9**, 638.

Dr. Hayduck explained the value of hops in their effect upon the keeping power of beer. The antiseptic action of hops in beer fermentation is perceptible even in the proportion of 0·25 hops to 500 of the wort. The effect of 1—15 parts of hops on the different bacteria is approximately the same. It follows that the antiseptic principle of hops is with difficulty soluble. Hops of the same kind act in the same way even when the extraction has gone on a longer or shorter time. Different kinds of hops, however, act very differently. The less valuable, but

fresh hops, including wild hops, are not inferior in their action on the fungus to the better qualities. Sulphuring hops does not improve matters. Hop-extracts of commerce were found to be useless. Hayduck considers the resins in the hops, of which he isolated two kinds, to be the antiseptic agents in the case of all bacteria. The bitter principle cannot be separated from the resin. The disappearance of the bitter principle in the course of fermentation by separation of the resin and oxidation has been fully confirmed. Preserved hops are also efficient in their action. In the discussion which followed, the feeling of practical brewers was against economy in the use of hops. They supported, however, the new method of boiling hops, which effects a certain economy. In considering the action of the pure-cultivation yeast obtained from the single cell, opinions were divided. In certain instances the results were excellent; in others, again, the fermentation was arrested, and a peculiar taste was imparted to the beer. Delbrück suggested that probably a higher temperature would produce a yeast freer from bacteria—that is to say, the isolation of the pure yeast. The method of Hayduck for regenerating the yeast by treatment with sugar solution of hops at a high temperature was strongly supported by the result of actual experiment. For washing the yeast, very cold water was recommended.

Dr. Francke spoke on the subject of the barley of the present year. He laid stress upon the troublesome treatment of kiln-drying in the use of stored malt of different sorts. According to Nervack, a stored malt is more moist, and forms, therefore, on grinding, a coarser material for the mash, which favours, therefore, the process of cleansing. To obtain a better quality of barley, it was proposed that the results of experiments with the barley of a certain district, together with the analysis, be communicated to the Agricultural Society before seed-ordering, in order to be in a position to choose a better brewing barley for seed.

Attention was called to the use of manures, as in many cases artificial manuring with Chili saltpetre and kainite was found injurious. Balcke suggested the use of kilns constructed with air ventilation, to prevent browning of the moist malt. Zimmer's centrifugal apparatus promises an extended use. The discoverer hopes to prevent frothing of the colder worts by changing the exit of the worts from the centrifugal. The cause of the red-colouring of white beer is supposed to be due to the presence of spherical bacteria. Different views were held on the subject of brewing-water. The efficiency of hard water was generally admitted. It was recommended to boil the water, and let settle before use, even with iron and calcium carbonate present.—J. B. C.

The Valuation of Pressed Yeast. W. Gintl. Ber. der Oesterr. Chem. Gesellschaft, 1885, p. 2.

THE comparative efficiency of different samples of yeast is best arrived at by comparative fermentation experiments, but when it is necessary to obtain absolute expressions, it is not sufficient, in addition to the usual microscopic and qualitative tests, to ascertain the amount of true yeast material present—it is also necessary to determine the proportion which the yeast bears to the starch. The author has found by analysis that an increase in the starch contents usually causes an increase within a certain limit—in the percentage of true yeast material, the diminution being in the water. The starch, however, by abstracting water from the yeast-cells causes a considerable proportion of these to shrink and wither, without absolutely killing them; so that the increased percentage of yeast material caused by the addition of starch results in a decreased efficiency; the fermentation is more feeble at the commencement, but more vigorous later on, when the proportion of starch to yeast is larger than when the reverse is the case. The addition of starch is not considered desirable by the author; it does not result in increased efficiency, and it is but a replacement of water, which costs nothing, by a comparatively costly material.—W. D. B.

Process for Preventing Subsidiary Fermentations in Substances employed in the various Manufactures based on Fermentation. C. D. Abel. From Dr. C. Meyer, Uerdingen, Germany. Eng. Pat. 5439, May 2, 1884.

THIS patent aims at removing from distillers' fermentations, micro-organisms, which would act injuriously upon the fermentation process and upon the quality of the product. The removal is effected by adding a voluminous body to the mash and filtering; this completely removes bacteria. The voluminous bodies used are:—

1. Freshly precipitated hydroxides, such as aluminium hydroxide.
2. Insoluble amorphous combinations, as phosphate of iron.
3. Silicic acid precipitated from its combinations.
4. Albumen, starch paste, etc.

The process can also be used for preparing an artificial ferment free from lactic acid-bacteria. The advantages claimed for the process are: Improved saccharification, pure fermentation, high yield of alcohol, reliable working, and complete utilisation of the starch in the malt.
—G. H. M.

Improvements in the Mode or Process of and Apparatus for Generating Carbonic Acid Gas, to be used in the Aeration of Draught Ale and other Beverages. W. H. How, Ongar. Eng. Pat. 10,109, July 14, 1884.

THIS apparatus consists of an outer vessel containing a solution of a carbonate or bi-carbonate, and a small narrow-necked vessel filled with sulphuric acid made into a paste by absorption with alum, covered with a tubulated bell-jar, and placed on the bottom of the outer vessel. The bell-jar is provided with stopcocks, and when these are opened the solution enters the bell and flows in upon the absorbed acid. The evolved carbonic acid bubbles through the solution, and is thus washed. When the apparatus is not required for use, the acid vessel is either closed by an automatic or other valve, or the stopcocks are closed, and the solution expelled from the bell by the accumulated carbonic acid.—W. D. B.

Improvements relating to the Extraction from Grapes or Raisins of various Substances, and to the Use or Application of the same for Colouring or other Purposes. E. H. Newby. From E. Thiebaut, Montdidier, France. Eng. Pat. 10,100, July 24, 1884.

THIS is a process for extracting the colouring matter from grapes or raisins, and from the residue in the manufacture of wine, by means of digesting with hot dilute alkali, and precipitating the colouring matter from the filtered solution with dilute hydrochloric acid. The precipitate is then purified by digestion with ammonia solution at 30° C. for some days. The colouring matter goes into solution, and can be obtained by distilling off the ammonia. The extracted substance may be used as a dye, or a pigment, or for colouring wines and articles of confectionery. It has tanning properties, and is a fast colour. In place of alkalis, the following substances may be used for extracting the colouring matter: Alcohols, ethers, turpentine, wood-spirit, carbon disulphide, acids, glycerine, or the wine itself.—G. H. M.

Process and Apparatus for Purification of Alcohol. C. D. Abel. From J. A. F. Bang and M. C. A. Ruffin, both of Paris. Eng. Pat. 10,870, Aug. 1, 1884.

THIS invention relates to a method and apparatus for purifying crude alcohol in order to obtain, by one single process of distillation, the total amount of ethylic alcohol free from essential oils and aldehyde. This is done by removing these latter with a solvent from the alcohol at 50° B. The solvent used is what is known as essence of petroleum, purified by shaking with strong sulphuric acid. The essential oils and aldehyde dissolve in this on agitation; whilst the hydrocarbon itself is insoluble in alcohol of 50° B. The hydrocarbon can be regenerated

by treatment with strong sulphuric acid. After treatment with the petroleum spirit, the alcohol is rectified as usual. A plan of the apparatus used is appended. —G. H. M.

Improvements in Beverages resembling Beer, and in the Process of Manufacturing the same. Thomas Etty, Liverpool. Eng. Pat. 11,297, August 15, 1884.

THIS is a process for manufacturing non-intoxicating beverages resembling beer from pearl-barley, malt, hops, sugar, and flavouring by boiling with water, and fermenting the liquid obtained with barm.—G. H. M.

Improvements in the Manufacture of Champagne or Sparkling Wines. J. C. Mewburn. From The Société Anonyme "La Vinicole." Eng. Pat. 12,105, September 6, 1884.

THIS invention consists in manufacturing sparkling wines by fermenting a mixture of wine and condensed must in a closed vessel, under pressure, at a temperature of 25° C. for twenty to twenty-five days. The wine is then transferred to another vessel, under a pressure of about six atmospheres, cooled, clarified and bottled, still under pressure. It is claimed that this yields a perfect wine in flavour and keeping power, and avoids the expense and loss incurred in the ordinary process of preparing sparkling wines. The amount of condensed must used varies from five to fifteen per cent., depending upon the nature of the wine employed.—G. H. M.

XVIII.—ELECTRO-CHEMISTRY.

Alloy for Electrical Conductors. H. H. Lake, London. From T. Shaw, Newark, New Jersey, U.S.A. Eng. Pat. 10,932, August 5, 1884.

THE object of this invention is to produce an alloy of aluminium, copper and phosphorus. The conductivity of this alloy is greater than that of iron, steel or phosphor-bronze. Alloys of copper containing from less than one per cent. to more than five per cent. of aluminium, and from one-twentieth to one per cent. of phosphorus, are employed. The amount of tensile strength required will regulate the proportions within the above limits. The copper is first melted, and the aluminium is added, a small quantity at a time, with a flux of palm oil, stirring well all the time with a pine stick; the phosphorus is then added, with stirring, and the alloy is poured into chill moulds.—J. T.

Elements for Voltaic Batteries. D. G. Fitzgerald and T. J. Jones, London. Eng. Pat. 1831 (September 25, 1884), 1885.

IN place of zinc the inventors employ as the positive element, lead, which is readily reducible from most of its compounds; as the negative element they employ a conductor (preferably of lead or carbon), coated or maintained in contact with lead peroxide. They claim (*a*) the use, for the purpose of electrolytically obtaining in bulk material for the elements of voltaic batteries, of a paste composed of equivalents of sulphate of lead and magnesia, or of lead sulphate, and an alkali; (*b*) the production of a negative element by subjecting a lead plate to electrolytic action as an anode in a solution of magnesium sulphate, in conjunction with a cathode, consisting of a number of superposed trays, containing a lead compound, to be reduced to the metallic form; (*c*) the treatment of lead sulphate obtained as the spent material in the working of lead primary batteries, with an alkaline solution, prior to reconverting such sulphate into peroxide by electrolysis; (*d*) the construction of electrolytic converting tanks or troughs, in which both the electrodes are constituted by a number of sets of superposed trays (preferably of lead), containing the materials to be acted upon electrolytically.—J. T.

XIX.—PAPER, PASTEBOARD, Etc.

Gas-fired Digestor for use in the Manufacture of Paper Pulp from Wood, Straw, etc. T. A. Reid, Liverpool. Eng. Pat. 9774, July 5, 1884.

THIS invention relates to a gas-fired digestor arranged with a peculiar system of flues, whereby the digestor can be fired with safety, economy, and directly. For details of construction, drawings and method of preparing wood pulp by the alkaline soda process with this apparatus, see original specification.—H. A. R.

Process and Apparatus for the Manufacture of Cellulose and Glucose from Wood and other Vegetable Products. Adolph Behr, Coethen, Germany. Eng. Pat. 9797, July 5, 1884.

HITHERTO cellulose has been prepared for technical purposes from wood by extracting all other substances from the wood by means of sodium hydrate. By the process described in above specification, the wood is treated by other reagents than sodium hydrate, and in such a way as to produce pure cellulose, and at the same time to convert into glucose as much as possible of the admixtures, consisting chiefly of carbohydrates. The wood shavings are dried by steam, then digested thoroughly with hot oil of turpentine or fusel oil, washed with steam, treated with dilute sulphuric acid, and again washed; the pure cellulose obtained may be either bleached at once, or dried and stored. The glucose and glucose-forming bodies are contained in the dilute sulphuric acid and in the condensed steam which was used for driving off the turpentine or fusel oil, and the glucose from these solutions is worked up by suitable means. —A. J. K.

Manufacture of Artificial Ivory. L. P. Merriam, Homerton. Eng. Pat. 10,765, July 30, 1884.

THE object of this invention is to produce a grained effect similar to real ivory, by means of xylonite, pyroxyline, celluloid or other equivalent material. The materials are reduced to sheets of different colours or shades, and placed in the machine known to xylonite-makers as a stuffing machine—*i.e.*, a cylinder and piston arrangement worked by hydraulic pressure or otherwise,—the machine being heated by steam to soften the material under operation. From this machine the material issues in rods or strips, which are again compacted into solid blocks by pressure. It is claimed that imitation ivory made by this process is more like the genuine article than that made in the ordinary way.—H. A. R.

Improvements in the Preparation of Safety Papers for Cheques, etc. J. Jamesen, Newcastle. Eng. Pat. 11,087, August 9, 1884.

THE object of this invention is the production of a safety paper, which shall indicate by a change in appearance any chemical or mechanical attempts at erasure or alteration. The inventor forms upon the paper a more or less intricate design, discoverable by reflected light, owing to a difference in the amount of glazing on the two surfaces. The design may be produced by pressure from plates or rollers, so as to slightly emboss the surfaces, or by extra application of size, forming thereby the said design, or else by the printing on of a soluble film. Another means is to highly glaze the whole surface first and then form the design by damp printing. The inventor may also use any convenient soluble chemical (*e.g.*, iodide of potassium), which by its reaction (*e.g.*, with mercuric chloride) will show whether the paper has been subjected to any sponging with a view to remove ink, such as what is known as "school-room ink," which contains no mordant.—H. A. R.

Utilisation of the Sodium Sulphide Liquors from the Manufacture of Cellulose. Oesterreichischer Verein für Chemische und Metallurgische Production. Ger. Pat. October 14, 1884.

THE waste liquors resulting from the preparation of cellulose by the sodium sulphide treatment, are worked

up to black ash by evaporation and subsequent furnacing with lime and coal. Sodium sulphide lye is obtained by boiling this black ash in water, or even by heating the dilute waste liquors under a pressure of about three atmospheres.—W. D. B.

Improvements in the Treatment of Dry Absorbent Bodies for Manufacturing various Useful Materials. E. Paul Louvot, Paris. Eng. Pat. 2979, March 6, 1885.

INVENTOR brings into contact with coal-, wood-, or petroleum-tar, products composed of cellulose, such as cardboard, paper, rope, string, thread, stuffs, canvas, dry paper pulp, etc. The vessel containing the mixture is hermetically closed, and by creating a vacuum the tar is forced into the pores of the cellulose. Pressure is then applied to the material. After being moulded into sheets, the material is placed between stones, and freed from tar-oils by heat and pressure. The resulting substance is termed "corozine." It is impermeable, uninflammable, acid-proof, unputrefiable, and capable of numerous applications—viz., for impermeable roofing, "cuir bouilli" or papier-maché products, barrels and pipes for acids and gases, etc.—H. A. R.

Improvements in the Manufacture of Fire and Waterproof Boards or Paper from Asbestos. W. E. Heys, Manchester. (From E. Ludewig, of Frankfort-a-O., Germany. Eng. Pat. 4151, April 2, 1885.

THIS invention relates to the manufacture of non-hygroscopic asbestos boards or papers. American or other soft fibrous asbestos, to the amount of 20-25% of the weight of the dry finished board, is taken and mixed with 25-35% of powdered aluminium sulphate. When well mixed the mass is impregnated with a 50% solution of zinc chloride in water. After washing with water, the mass is treated with ammonia, and after another washing with water, an addition is made of a 10% solution of resin soap, mixed with an equal amount of sulphate of alumina. To the pulp thus prepared in the rag-engine, inventor adds above 35% flour of ordinary or "green" asbestos stone. Finally, 5 to 8% of barium sulphate is added, and when diluted with water as required, the pulp may be employed for either machine- or hand-made paper. It is proposed to prepare a material suitable for roofing purposes, by covering on both sides ordinary tarred roofing paper or felt with asbestos paper prepared as above.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Production and Use of Hydrogen Peroxide. W. Lindner. Chem. Zeit. **9**, 940 and 976.

THE introduction into commerce of a peroxide of barium of 70 to 75 per cent. rendered it possible to prepare hydrogen peroxide for about one-quarter the cost of the English product, the purity and stability being equal. In 1878 experiments were made on the bleaching of lawn and ivory with encouraging results. The preparation of hydrogen peroxide is best effected by the old peroxide of barium method. The peroxide must be as pure as possible, very finely divided by sieving with a considerable quantity of water, and freed from barium hydrate by washing. The decomposition of the peroxide of barium may be effected by means of hydrofluoric, hydrofluosilicic or phosphoric acid, but best by one of the two latter. Oxalic acid gives a good yield, but the product is not stable. The introduction of the pasty peroxide of barium into the dilute acid must be very gradual, the temperature must not rise above 20° C., and the liquid must be maintained in constant agitation. When the neutralisation of the solution is sufficiently approximated the liquid is separated from the sediment—after adding a little phosphoric acid when the decomposition was effected by hydrofluosilicic acid,—and freed from dissolved baryta by the addition of a little sodium sulphate. The most stable peroxide of hydrogen is that which has been prepared with phosphoric acid, and contains a small proportion of that acid in the fr e state; the addition, however, of phosphate of soda to p oxide of hydrogen containing free acid, other than ph phoric, is found to increase the stability. The strengt of a solution of peroxide of hydrogen is best determi ed by titration with solution of permanganate conta ning 7·9grm. $KMnO_4$ per litre. A convenient plan giving results within 0·1 per cent. in about three minutes is to take 2cc. of peroxide in a graduated tube holding 35cc., add five to six drops of hydrochloric acid, and then the standard permanganate solution, gradually, and with thorough agitation, until the contents of the tube are of a red or brownish colour; the quantity of solution added is now read off, 5cc. representing 1·0 per cent. of H_2O_2. When really stable, hydrogen peroxide can be stored in pitched barrels, tin cans, either varnished with amber varnish or plain, as well as in glass bottles; and it has been found that, avoiding high temperatures and the action of light, the deterioration on storing for three months does not amount to so much as 0·1 per cent. For the bleaching of ivory and other compact materials, it is only necessary to immerse the pieces in the acid solution till sufficiently white, the tint being observed in a sample after drying. For bleaching fibrous substances such as hair, it is advisable either to employ an ammoniacal solution of the peroxide, or else first immerse the material in the usual acid solution, allow the excess of liquid to drain away, and place the thus moistened substance in an ammoniacal atmosphere; this latter plan is specially applicable to Tussah silk, which must not lose its lustre. The employment of hydrogen peroxide as a discharge in printing is recommended by Schmid. For household purposes the peroxide may be safely used to remove from white goods stains of ink, wine, fruit juice, and the like, the best plan being to moisten the spots with the peroxide and add a few drops of ammonium chloride solution. Ornaments of bone and ivory yellow with age are readily whitened in a few days; fabrics yellow with age are also readily and safely restored with the peroxide. Péan and Baldy recommend the peroxide for the disinfection of wounds, Pommer and Ebell for the regulation of the fermentation of beer, wine, must, and worts; Krandauer, however, believes that a foreign taste is thus imparted to the liquor.—W. D. B.

On Narceine. A. Claus. Ber. **18**, 1569.

Narceine-ethylbromide $C_{23}H_{29}NO_9.C_2H_5-Br$. is obtained by heating narceine with a slight excess of ethylbromide with back-flow condenser, or in a closed tube in the steam-bath.

Narceine-ethylchloride is obtained from the corresponding bromide by decomposition with silver chloride. It forms well-characterised platinum and mercury double chlorides.

Narceine-ethylnitrate and oxalate can likewise be prepared from the bromide by double decomposition with the analogous silver salts.

Narceine-methyliodide, chloride and nitrate are prepared similarly to the ethyl derivatives. The platinum double salt of the methyl-chloride separates out as a crystalline powder, by treating an aqueous solution of the iodide with HCl. It is slightly soluble in water.

By boiling the above haloid derivatives of narceine with alkali, hydracid is formed, and a tertiary base is produced with the alcohol radical. In this way methylnarceine $C_{23}H_{28}(CH_3)NO_9$ has been prepared from narceine-methyliodide. The bases obtained in this way dissolve in dilute acids, and are reprecipitated with an alkali. They differ in this way from the quaternary ammonium bases—*e.g.*, narceine-methylhydroxyd, the salts of which are not decomposed with ammonia. Benzylnarceine has been obtained from narceine-benzylchloride by boiling with potash solution.

By the oxidation of narceine with potassium permanganate a new base of the formula $C_{17}H_{25}NO_{10}$ has been prepared.—J. B. C.

Papaverine. A. Claus and E. Hüetlin. Ber. **18**, 1576.

To prepare the haloid alcohol radical additional products of papaverine, the best method is to heat the substances

together in a closed tube on the water-bath. The compound of ethylbromide and papaverine is readily obtained in this way; whereas, those with methyl- and ethyl-iodide and benzyl-chloride require heating 18-20 hours. The authors have prepared papaverine-methyl and -ethyl-iodide ethyl-bromide, chloride, and nitrate and benzyl-chloride of the general formula, $C_{21}H_{21}NO_4.RX$.
—J. B. C.

Benzoyl-ecgonine. W. Merck. Ber. **18**, 1594.

A CRYSTALLINE by-product in the preparation of cocaine was heated with concentrated HCl in a closed tube to 100°. The acid liquid was poured off from the crystalline product formed, and both portions separately tested. The crystalline portion was found to be benzoic acid, the acid liquid on shaking out with ether gave a crystalline substance, from which, on treating with moist silver oxide, a base separated having the characteristic properties of ecgonine. The analysis of the original substance and its products of decomposition indicate the following constitutional formula :—$C_9H_{14}NO_3 - C_7H_5.O$.
—J. B. C.

The Constitution of Cocaine. G. Calmels and E. Gossin. Compt. Rend. **100**, 1143 46.

THE authors obtain by decomposition of cocaine hydrochloride with crystallised bariumhydrate and water at a temperature of 120°, the same products, which Lossen (*Ann.* 133, 351) prepared—viz., methyl-alcohol, benzoic acid and a crystalline substance (A) which, with HCl, yields benzoic acid and ecgonine. From the latter, by heating or evaporating the solution of its platinum double salt, the modified salt $(C_9H_{15}NO_3)_2PtCl_7$ is formed easily soluble in water. The alkali compounds of ecgonine crystallise with difficulty, and are decomposed with CO_2. The barium salt has the formula—

$$(C_9H_{14}NO_3)_2Ba + NH_2O.$$

The compound (A) gives, on distillation, an oil which passes over mostly at 210-230°, a crystalline hydrochloride and an orange platinum double salt. It is an isotropine which decomposes on distillation with baryta into ethylamine, and an oil free from nitrogen (similar to tropine, which yields methylamine). These compounds are derived from ethyltetrahydropyridine—

$$CH_2{<}\begin{matrix}CH_2.CH_2\\CH:CH\end{matrix}{>}N.CH_2.CH_3$$

isotropine being the methoxy derivative, ecgonine a carboxylated isotropine, and cocaine $C_{17}H_{21}NO_4$ the benzoyl-methyl ether of ecgonine.—J. B. C.

XXI.—EXPLOSIVES, MATCHES, Etc.

Progress in the Manufacture, Application and Knowledge of Explosives. Dingl. Polyt. J. **256**, 408.

SOME experiments with "kinetite," a gelatinous mixture prepared according to Petry and Fallenstein's patent* (Ger. Pat. 31,786, June 18, 1884), are recorded in the Berg- und Hutten-Männischen Zeitung, 1885, p. 65. As compared both with gunpowder and dynamite, the results were very unfavourable; moreover, kinetite labours under the disadvantage of requiring a very powerful initial detonation.

Favier (Ger. Pat. 31,411, May 27, 1884) proposes to prepare a non-hygroscopic powder by mixing paraffin, resin or nitronaphthalene with hygroscopic nitrates, such as those of soda and ammonia. Apart from the somewhat uncertain degree of security against absorption of moisture thus attained, this composition labours under the great disadvantage of requiring an initial detonation provided by about 20 per cent. of gun-cotton or dynamite placed in the perforation of the compressed cartridge.

In the Transactions of the Technical Society of the Pacific Coast, 1884, i. 5, Jenssen discusses the causes of accidents in the manufacture of highly-explosive substances.

In consequence of certain representations which have been made in reference to the fraudulent conveyance of powder and sporting ammunition, a series of experiments has been carried out by the French Committee on Explosive Substances, to determine how far the conveyance of ammunition is to be considered attended with danger. The report of the committee is published in *Bulletin d'Encouragement*, 1885, vol. xii. p. 26. The committee arrived at the conclusions that with the varieties of ammunition mentioned below there was complete security against the detonation *en masse* of a package being caused by the explosion of one of its contents: Caps in tin-plate boxes, charged with 65 per cent. silver fulminate, 35 per cent. potassium nitrate; caps loaded with Gaupillat's mixture, packed in paste-board boxes; Flobert's caps containing 2 parts silver fulminate, 1 part of potassium nitrate, 1 part of sulphide of antimony, in tin boxes; caps for central fire cartridges in paste-board boxes; Gaupillat's cartridges of small calibre in paste-board boxes; revolver cartridges of both systems, sporting cartridges, and metallic rifle cartridges of all kinds. Flobert's and revolver cartridges may safely be sent express in boxes of not more than 5kilos., caps in boxes of not more than 2·5kilos. gross weight. The committee is also of opinion that detonators should not be regarded as safety ammunition.

Experiments carried out by Berthelot and others, as to velocity with which the detonation of various explosives is propagated, are recorded in the *Revue Industrielle*, 1885, p. 188. The explosives were contained in thin metal tubes of from 1 to 2mm. internal diameter, and from 100 to 200mm. long. The determinations were made partly with the aid of Sébert's and Le Boulengé's chronographs and partly with Sébert's velocimeter. The velocity of propagation was found to increase with the diameter of the charge, with the density of the explosive, and to be influenced by the composition, but not by the shape of the tubes. In tubes of 3mm. diameter nitroglycerine refused to detonate at 12°, detonated only partially at 14°, and required to attain to a temperature of 18° before it could be completely exploded under these circumstances. The following numbers give in meters per second the mean velocities of propagation of detonation of different explosives :—

Compressed gun-cotton in lead tubes 5200, in tin tubes, 5916. Granulated gun-cotton, 4770. Starch powder, 4885. Nitromannite, 6908. Nitroglycerine, 1078. No. 1 dynamite from Vonges, 2668. Panclastite, 4685. The velocity is less at the commencement than later on, and it was found that, measured at intervals of 25 meters, the velocity of propagation in compressed gun-cotton varied in a length of 100m. from 4661 to 5980m. per second.—W. D. B.

Improvements in Presses or Apparatus for the Manufacture of Compressed Gunpowder. H. H. Lake, London. From H. Gruson. Eng. Pat. 7108, May 1, 1884.

THE improved form of press which is here patented differs from presses heretofore constructed, in that the table containing the matrices moves with the lower set of plungers, the upper set of plungers being motionless.
—W. D. B.

An Improved Explosive Compound. Thomas Wilkins, Peckham. From T. Petry and O. Fallenstein. Eng. Pat. 10,986, August 6, 1884.

A GELATINOUS mass is obtained by dissolving gun-cotton in nitro-benzene or other nitro compound of the aromatic group of coal-tar derivatives, and finely-powdered chlorate or nitrate of potassium or other base, together with sulphur, free or combined as sulphide, added to the jelly. The powdered salts are first well mixed and kneaded with the jelly till a homogeneous mass is obtained.

* See Abstract, second column of this page.

The sulphur or sulphide is then introduced, and the whole well worked up. The best proportions are :

16 to 21 of the aromatic nitro compound.
$\frac{3}{4}$,, 1 of gun-cotton or other form of nitro-cellulose.
$82\frac{1}{4}$,, 75 of chlorates and nitrates.
1 ,, 3 of sulphur or sulphide.

The resultant explosive is of a plastic nature, and may readily be formed into cartridges.—W. D. B.

Improvements in the Manufacture of Explosives. C. W. Curtis, London. Eng. Pat. 15,647, November 27, 1884.

THIS invention has reference to the preparation and use in the manufacture of gunpowder, of charcoal rich in hydrogen and comparatively poor in carbon, derived from cocoa-nut fibre and other fibrous substances. Such charcoal, in which the hydrogen bears to the carbon a proportion of one to ten or one to eleven, is obtained by slowly charring or roasting, for from four to six hours, the fibrous material in the usual apparatus consisting of a cylinder revolving within a retort heated to a dull or dark-red heat. Charcoal so prepared is of a rich dark-red colour. The proportions of the ingredients of powder into which this charcoal enters, are preferably 1 of sulphur, 25 of potassium nitrate, and $5\frac{1}{2}$ of the charcoal. —W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Analytical Notes. C. de la Harpe. Bull. Mulhouse, 1885, 245.

(*a*) THE normal sulphates of the alkali metals are decomposed on heating them with halogen hydracids. Thus: 2·18grm. K_2SO_4 were heated in a water-bath with HCl, and the residue dried at 120-140°, till the weight was constant; it then weighed 2·61grm., showing that conversion into acid sulphate had taken place, according to the equation $K_2SO_4 + HCl = KCl + KHSO_4$. Titration of the residue showed that the quantity of acid sulphate obtained was ninety per cent. of the theoretical. With sulphate of soda seventy-seven per cent. underwent conversion. With potassium sulphate and hydrobromic acid, the corresponding decomposition approaches completeness, ninety-five per cent. and ninety-nine per cent. being realised in two experiments, the residue being dried at 140°. The reversal of the decomposition takes place at temperatures varying with the several hydracids; thus, in the case of hydrofluoric acid, when the residue was dried at 110°, it contained eighty per cent. of the potassium sulphate as hydrosulphate; dried at 140°, on the other hand, only forty to forty-five per cent. With nitric acid and potassium sulphate the decomposition reached eighty-two per cent., the residue being dried at 140°. Formic and acetic acids were found to be entirely without action. (*b*) To determine the acidity of solutions which cannot, from whatever cause, be directly titrated with alkali, the author distils from sodium acetate, added to the solution in sufficient quantity. The distillation is effected under diminished pressure, whereby it may be carried nearly to dryness, without allowing the temperature to exceed 120°, and the whole of the acid—*i.e.*, the equivalent of acetic acid—obtained in the one distillate. This process is not applicable to solutions containing salts, which are dissociated on boiling—*e.g.*, salts of iron, aluminium and chromium. (*c*) In determinations of the alkaline earth metals in solutions containing ammonium sulphydrate, the author points out that the usual preliminary of acidification with hydrochloric acid and boiling is attended with the danger of the formation of sulphuric acid, and consequent precipitation of the metals. (*d*) The precipitation of tin and arsenic, as sulphides, from solutions of stannates and arseniates, is much expedited by heating with ammonium sulphydrate, in presence of ammonia in excess, at 80-90°. Hydrochloric acid is then added in quantity sufficient to decompose the sulphydrate, and the metals are completely precipitated as sulphides. (*e*) In preparing dithionic acid by the oxidation of sulphuric acid, the author recommends the employment of the manganic oxide in the hydrated form. The gas is passed into water at 0°, and the oxide added from time to time in the form of paste, taking care to keep the sulphurous acid in excess. (*f*) The author describes a triangle for supporting crucibles, the dimensions of which may be varied at pleasure, consisting of three wires, which may be made to include any angles by insertion into holes pierced in series, in a suitable ring, at corresponding segments. Such a triangle will be found especially economical in the case of platinum wire. (*g*) The ordinary method of carrying out Bunsen's process of indirectly estimating elements and radicles which may be made to liberate iodine from potassium iodide, has the defect of being difficult of control. The author describes a simple apparatus whereby the distillation may be conducted in a stream of carbonic acid gas, and the process thereby brought within the complete control of the operator. The author recommends the process for the estimation of nitrates. He is investigating its adaptation to the indirect determination of sulphurous acid and other reducing agents.—C. F. C.

Determination of Strength of Permanganate Solutions. G. Krüss. Ber. **18**, 1580.

TO avoid the usually tedious process for determining strength of solutions of liquids possessing a characteristic absorption spectrum, the author proposes to utilise this property for such determinations, as being more rapid and equally reliable. Quantitative spectrum analysis gives us a method for determining the coefficient of extinction (E) in certain regions of the spectrum of a solution, of which the relative absorption power for light (A) is known. The concentration (C) of the solution can be determined for E.A = C. Potassium permanganate was prepared pure, according to Gregory's method, and the extinction coefficient determined for different strengths of solution by the method of Vierordt. The observed results agree well with the ordinary volumetric determination with standard sodium hyposulphate solution. For further details and table of observations, the original paper should be consulted.—J. B. C.

Dimethylamidoazobenzene as an Indicator in Alkalimetry. B. Fischer and C. Philipp. Chem. Zeit. **56**, 998.

THE end reaction is marked by a change of colour, from yellow to pink. The indicator is prepared by dissolving 9·3 parts aniline in 30 parts 25 per cent. hydrochloric acid, diluting with water, and then adding an aqueous solution of 7 parts sodium nitrite to the cooled liquid. The solution is then poured into one containing 12 parts dimethylaniline dissolved in 15 parts 25 per cent. hydrochloric acid; finally about 30 parts sodium acetate are added until the solution smells of acetic acid. Crystals separate out which can be purified by crystallisation from alcohol. It is neutral towards free carbonic acid. —S. R.

Gravimetric Determination of Manganese. H. v. Jüptner. Chem. Zeit. **9**, 692.

FOR the determination of manganese in iron and steel, also in iron ores and slags, the following method is adopted. The HCl solution of the substance to be tested (in which any ferrous salt must be previously oxidised with $KClO_3$) is neutralised with Na_2CO_3 in a graduated flask, NH_4Cl solution added, precipitated cold with $BaCO_3$, and after adding an excess of ammonia digested for some time by agitation. It is then filled to the mark, well mixed and filtered through a dry filter. An aliquot part of this filtrate is treated with H_2SO_4 to precipitate the barium present, and neutralised with ammonia with or without previous filtration; heated to boiling and precipitated with $(NH_4)_2S$. It is then filtered through a small filter and washed with $(NH_4)_2S$ water. If the precipitate is small it may be treated directly with boiling acetic acid, and to limit the amount of liquid the funnel should be furnished with a glass tap; with larger quantities, the precipitate is washed with acetic acid through the filter

into a beaker. The acetic acid solution is filtered off into a weighed platinum basin evaporated to dryness, heated and weighed as Mn_3O_4.—J. B. C.

Apparatus for Fractional Distillation. F. Anderlini. Chem. Zeit. **9**, 941.

THIS apparatus consists of a worm of five or more convolutions, according to the number of which, four or more upright tubes corresponding with the connecting tubes in Bel and Heninger's apparatus, connect each coil of the worm with that next but one below it. The diameter of these connecting tubes is somewhat contracted at the bend which they take before entering the lower coil. These connecting or draining tubes serve to prevent an accumulation of liquid in the worm, and thus obviate any risk of a quantity of liquid being ejected into the condenser, should a sudden evolution of vapour take place.—W. D. B.

Examination of the Ash of Vulcanised Caoutchouc. C. Reinhardt. Stahl und Eisen, 1884, p. 649.

FOR the estimation of the ash in vulcanised caoutchouc, from 0·5 to 1grm. of the sample is cautiously heated in a covered crucible until the evolution of gas has ceased, and then in the open crucible until the organic matters are burnt off. The stronger the heating the less accurate are the results, since calcium carbonate loses CO_2. Gypsum is converted into calcium sulphide, and oxide of zinc transformed into sulphide or reduced and the metal volatilised. For the accurate estimation of the mineral constituents, sulphur excepted, from 0·5 to 1grm. of the caoutchouc in shavings is warmed in a beaker upon the water-bath with nitric acid of 1·4 sp. gr., until solution is effected. After cooling somewhat the solution is transferred to a porcelain basin, evaporated upon the water-bath to dryness, moistened with hydrochloric acid, and dissolved in water. Silicic acid and barium sulphate remain undissolved. The solution contains oxide of zinc, lime, magnesia, ferric oxide, and alumina, which are separated in the usual manner. The total sulphur is estimated by warming about 1grm. of the sample with 20cc. of nitric acid, potassium chlorate being thrown in from time to time. The solution is evaporated, dissolved in hydrochloric acid and water, filtered, and the sulphuric acid estimated in the filtrate and also in the barium sulphate, forming a part of the insoluble residue. The sulphur added to effect the vulcanisation is estimated by burning a portion in a current of oxygen at a low temperature and passing the gases of combustion into hydrochloric acid containing bromine; or the caoutchouc may be heated in a glass tube closed by fusion, and the sulphur estimated in the distillate.

—W. D. B.

Estimation of Fat in Palm-nut Meal and other Palm-nut Preparations. V. v. Wilan. Bied. Centr. **14**, 140-141.

WHEN treating palm-nut meal in the ordinary way for fat determination in Soxhlet's apparatus for the usual time, 3 to 4 hours, low results are obtained, owing to the dense nature of the cake, and a subsequent extraction for from 5 to 6 hours yield another 1 per cent. of fat. Other feeding materials yield up their fat to within a very minute quantity during the four hours' extraction. This peculiarity of palm-nut preparations is attributed to the mechanical retention of fat which is closely pent up in the cells; and can, therefore, only be attacked by the ether with great difficulty, and only after some time comes into solution. The results of experiments with this material ground to different degrees of fineness confirm this view, for coarse samples retained considerable quantities of fat, whereas finely-pulverised samples yielded up all their fat in the 3 to 4 hours.—D. A. L.

Improvements in Sampling and Testing Apparatus for Spirituous Liquors or other Liquids. J. O'Neil Mackle, Liverpool. Eng. Pat. 12,585, September 19, 1884.

THIS improvement consists essentially of a glass cylinder fitted with a valve at bottom opening inwards, acting automatically or by hand, so that an average sample or a sample at any required depth may be taken from a cask or vessel containing the liquid. The cylinder carries inside a hydrometer, inside which is a thermometer, the means for ascertaining the specific gravity and the temperature of the sample being thus comprised in the sampling instrument.—G. H. B.

An Improved Method of and Apparatus for the Quantitative Estimation of Hæmoglobin in the Blood. A. M. Clark, Middlesex. From Dr. E. Fleischl, Vienna. Eng. Pat. 5991, May 15, 1885.

THE method consists in comparing the depth of colour of a solution of the blood in water with a standard made of ruby glass ground into a wedge-shape and fixed in a form of chlorimeter, which admits of the thickness of the wedge at any point being read off on a scale. In order to provide the same tone of colour being transmitted through the ruby glass and the blood, the yellow light of a lamp or candle is used for the illuminant—G. H. B.

Test for Chloralhydrate. M. Hirschfeld. Archiv d. Pharm. 1885, **223**, 26.

BY adding to a solution of chloralhydrate a small quantity of calcium hydrosulphide, a red colouration ensues after the lapse of about half-a-minute. A fainter but still clearly perceptible reaction takes place when a solution of sulphuretted hydrogen and lime water are added to a chloralhydrate solution.—F. M.

A New Reagent for Aromatic Orthodiamines. O. Hinsberg. Ber. **18**, 1228.

FOR the detection of small quantities of *m-p*-toluylenediamine and *o*-phenylenediamine the author found phenanthrene-quinone a very suitable reagent. The reaction depends upon the formation of diphenylene quinoxalines, which are only slightly soluble. An alcoholic solution of the diamine to be tested is boiled for a short time with a solution of phenanthrene-quinone in glacial acetic acid. If an orthodiamine be present, a bulky precipitate, consisting of fine yellow needles, is formed while the liquor is still boiling. On separating it by filtration and moistening it with hydrochloric acid it turns deep-red. The paradiamines form a similar compound with phenanthrene quinone, but it is not acted upon by hydrochloric acid. The author thinks that this reaction may probably be generally suited for the detection of aromatic orthodiamines.—S. H.

New Books.

ALKALI, ETC., WORKS REGULATION ACT, 1881. Twenty-first Annual Report on Alkali, etc., Works. By the CHIEF INSPECTOR. Proceedings during the Year 1884. London: Printed by Eyre & Spottiswoode, East Harding Street, Fleet Street. 1885. Price 6d.

THIS Government Blue Book, just recently issued, contains the Chief Inspector's Annual Report to the Local Government Board for the year 1884. It contains in all 91 pages of matter, preceded by a table of contents arranged as follows:—Introduction; Alteration of Districts; Arrangement of Districts; Location of Inspectors; Wool Carbonising Works; Venetian Red Works; Manure Works; Deposit of Alkali Waste; Bleaching Powder Chambers; Apparatus for Testing the Air of the Chambers; Proposed Rule for Bleaching Powder Makers; Provisional Orders; Prosecution under the Act; Inspectors' Reports—the districts reported being numbered and named as follows:—District No. 1. Scotland and Ireland; No. 2. North; No. 3. Cheshire, North

Wales, and part of Lancashire; No. 4. East Lancashire and Yorkshire; No. 5. Midland; No. 6. South West; No. 7. South East, District of Widnes. From the Report it would appear that sulphate of ammonia works are being gradually but surely made innocuous through the persevering efforts of the Chief Inspector and his colleagues. In no case is sulphuretted hydrogen now allowed to escape mingled with carbonic acid from the sulphate tanks as of old, and the turning the gases into boiler-flues or the after-parts of fire-places at best only a process of conversion of one form of nuisance into another, is also being rapidly discontinued in favour of the direct condensation of the sulphuretted hydrogen in oxide of iron purifiers, by which the sulphur can be readily recovered and the oxide of iron regenerated for renewed use. (See pages 48, 49, 59, and 72, *loc. cit.*).

A Treatise on the Manufacture of Soap and Candles, Lubricants and Glycerin. By Wm. Lant Carpenter, B.A., B.Sc., etc. With 87 illustrations. E. & F. N. Spon, 125 Strand, London. New York: 35 Murray Street. 1885.

This work, as the preface informs us, has in part appeared, though in a detailed manner, in Spon's "Encyclopædia of Manufactures and Raw Materials." In the present work the whole subject matter is rearranged and very carefully revised. The book contains 332 pages of subject matter, illustrated with 87 woodcuts, a table of contents, and an alphabetical index covering 12 pages. It is of medium 8vo size, and is bound in cloth. The work is subdivided into fifteen chapters treating of the various portions of the subject, these chapters being preceded by a "Historical Epitome and References." The writer of the present notice has himself seen and examined the remains of the old Pompeiian soap factory referred to, with its lead-lined pans, each containing about 15 to 20 gallons. It forms one of the most interesting relics in the ruined city. He can thus bear full testimony to this interesting fact mentioned in Mr. Carpenter's "Historical Epitome." Chapter I. Theoretical Principles. Chapter II. Raw Materials: Their Sources and Preparation. Chapter III. Raw Materials: Refining, Clarifying and Bleaching. Chapter IV. Raw Materials: Their Proximate Analysis. Chapter V. Caustic Alkali, and other Mineral Salts. Chapter VI. Manufacture of Household Soaps: The Process of Saponification. Chapter VII. Treatment of Soap after its Removal from the Soap Copper: Household, Manufacturers', and Toilet Soaps. Chapter VIII. Theory of the Action of Soap—Its Valuation and Analysis: Distribution and Position of the Trade. Chapter IX. Lubricating Oils, Railway and Waggon Grease, etc. Chapter X. Candles: Raw Materials, their Sources and Preliminary Treatment. Chapter XI. Processes for the Conversion of Neutral Fats into Fatty Acids: The Manufacture of Commercial Stearin. Chapter XII. The Manufacture of Candles and Night-lights: Their values as Illuminants. Chapter XIII. Glycerin. Chapter XIV. Summary of Patents. Chapter XV. Bibliography.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, and MACHINERY.

8710 G. Raven, London. Improvements in or relating to smoke-consuming furnaces or fire-places. July 20

8866 D. Jarves, London. Improvements in retorts and seals therefor. Complete specification. July 22

8970 A. C. Hill, Middlesbrough. Improvements in regenerative hot-blast stoves for heating air, steam, or other gases. July 25

9204 D. K. Clark and W. J. E. Foakes, London. Improvements in filter-presses. July 31

9225 W. Weldon, Burstow—Communicated by A. R. Pechiney et Cie., France. Improvements in apparatus for heating solid substances out of contact with the products of the combustion of the fuel employed. August 1

9231 H. W. Todd, Liverpool. Improvements in metallic drums for containing chemical and other substances. Aug. 1

9275 J. Ruscoe, Manchester. Improvements in machines for facing the ends of, and turning or boring gas-retort mouths, lids, pipes, or valves of D, oval, or any other shape or section than round; also for cutting oval-shaped holes in boiler and other plates, castings, and the like. August 1

9298 A. H. W. Brown, London. Improvements in means for economising fuel and consuming smoke in steam boilers. August 4

9316 W. L. Wise, London—Communicated by J. G. Hansel and F. L. Krumbiegel, Saxony. Improvements in furnaces. August 1

9338 W. A. Martin, London. An improved mode of developing and increasing the draught of furnaces. August 5

9387 W. Thomlinson, London. Improvements in stoves for heating the blast for blast furnaces, or for other analogous purposes requiring hot blast. August 6

9416 J. G. Betts, London. Improvements in apparatus for heating or cooling air for drying or for other purposes. August 7

9437 W. W. Nightingale, London. Improvements in means or apparatus for forming and maintaining ice surfaces, and treating the atmosphere of glaciaria or such like places, and for cooling chambers. August 7

9446 W. G. Hudson and C. R. Bonne, Manchester. An improved apparatus for carburetting atmospheric air and other gases. August 8

II.—FUEL, GAS, and LIGHT.

8669 F. Siemens, London. An improvement in gas-producers. July 17

8715 S. A. Sadler, London. Improvements in means and apparatus for utilising mineral, tar, and other oils as fuel. July 20

8816 P. Jensen, London—Communicated by J. E. Dery, Belgium. Improvements in or in connection with apparatus for the carburation of gas in railway and other carriage lamps and lanterns. Complete specification. July 21

8880 J. Hanson, Bingley. Improvements in the construction or arrangement of hydraulic mains and ascension pipes, connected therewith for the manufacture of coal gas. July 23

8882 J. Bromilow, Liverpool. Improvements in apparatus for the application of gases to metallurgical and other purposes requiring high temperatures. July 23

9089 F. L. Harris, London. Improvements in gas batteries for the production of electric currents. July 28

9203 J. Robbins, London. An improved artificial fuel. July 31

9302 A. R. Upward and C. W. Pridham, London. Improvements in gas batteries. August 4

9365 H. Baker, Derby. Lighting by coal gas, houses, streets, etc., by which a much greater lighting power is obtained from the gas. August 6

9541 R. Dempster, jun., Manchester. Improvements in centre valves employed in connection with gas purifiers. Complete specification. August 11

9513 H. E. A. Wallis and H. T. Ratcliff, London. An improved arrangement or means for effecting direct conduction of gas-flame heat to hydrocarbon for enriching the flame and increasing light. August 11

9591 J. McCulloch and W. Black, Glasgow. Improvements in machinery for preparing and compressing materials for use as fuel or for smelting purposes. August 12

9650 H. E. A. Wallis and H. T. Ratcliff, London. Improved construction of carburetting apparatus for burning coal gas with hydrocarbons. August 13

9679 H. J. Rogers, Watford. Improvements in gas retorts, and in apparatus connected therewith. August 14

9701 N. J. Holmes, Sevenoaks. Improvements in the construction of self-igniting and inextinguishable signal lights for marine and other purposes. August 14

9720 B. Andreae, Halifax. Improvements in the generation of gas for light and heat purposes, and the necessary apparatus thereto. August 15

9725 R. W. Anderson, Liverpool. A new and improved means of economising coal, consuming smoke, and raising the heat to a higher degree in the furnaces of steam boilers. August 15

9761 J. J. Barclay and J. Thompson, London. Improvements in gas producers and apparatus for supplying gas to marine and stationary steam-boiler and other furnaces. August 17

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

8973 L. Mond, Liverpool. Improvements in or incidental to the separation of ammoniacal products and tar from producer or other furnace gases. July 25

9116 R. de Soldenhoff, London. A continuous arrangement of regenerating apparatus for coke-ovens. July 29

9611 A. A. Vale, London—Communicated by the Chemische Fabriks Actien Gesellschaft, Germany. Treatment of the waste acids resulting from the purification of the light oils of coal-tar for the utilisation of the said waste acids, and of the by-products resulting therefrom. August 12

IV.—COLOURING MATTERS AND DYES.

9211 M. Hoffmann and A. Weinberg, London. The production of new azo colours. July 31

9510 H. J. Haddan, London—Communicated by The Farbenfabriken, verm. Bayer & Co., Germany. A new manufacture of violet and blue azo-dyes. August 10

9694 G. M. Snow Horton, London—Communicated by Root and Tinker, United States. Recovering the excess of sulphuric anhydride used in the manufacture of certain dyes, etc. August 11

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

8793 W. Mather, London. Apparatus for treating textile materials with liquids, gases, or vapours. July 21

8794 W. Mather, London. A process for bleaching vegetable textile fabrics. July 21

8795 C. D. Abel, London—Communicated by La Société Dubus, Cojet, et Cie., France. Process for the removal of vegetable impurities from wool by chemical means in combination with steam. July 21

8890 J. C. Siegerist, Manchester—Partly communicated by E. Mittler, France. A new or improved process of treating and weighting silk. July 23

9129 A. M. Clarke, London—Communicated by J. Haag, France. An improved machine for decorticating ramie and other similar fibrous plants. July 29

9377 C. Court, S. Hersee, H. C. Williams, and S. Hersee, London. Improvements in treating all vegetable substances for the production of fibre for use for spinning purposes and for the manufacture of paper pulp. August 6

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

9197 H. J. Haddan, London—Communicated by E. Haeffely, France. Improved process for dyeing cotten yarn. July 31

9690 T. Salt and W. Stead, London—Communicated by F. Pasquay, Germany. Improvements in apparatus for washing, scouring, bleaching, dyeing, steaming, drying, and otherwise treating fibrous material in the form of slivers, slubbings, rovings, yarns, or fabrics. August 11

VII.—ACIDS, ALKALIS, AND SALTS.

8692 F. Foster, London. Generating carbonic acid gas automatically. July 18

8723 W. P. Thompson, Liverpool—Communicated by Solvay et Cie., Belgium. Improvements in filters applicable for caustic soda solution. July 20

8724 W. P. Thompson, Liverpool—Communicated by Solvay et Cie., Belgium. Improvements in the manufacture of chlorine from by-products of the ammonia-soda process, or similar chemicals obtained from other source. July 20

8838 W. P. Thompson, Liverpool—Communicated by J. Weeren and F. Weeren, Germany. A new or improved process for obtaining silicates of the alkalis and alkaline earths from the corresponding sulphates, together with sulphureous acid or sulphur, and apparatus therefor. Complete specification. July 22

8916 C. F. Claus, jun., London. Improvements in the process of obtaining phosphoric acid and alumina from Redondo and similar phosphates of alumina. July 23

8993 F. Brunjes, London. An improved process for the production of carbonate of potassium from chloride of potassium or sulphate of potassium. July 25

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9561 A. Wilkinson, London. An improved construction of ventilating brick. August 11

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES

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On the Morning of Sunday, the 20th inst., at his residence, Rede Hall, Burstow, Surrey,

WALTER WELDON, F.R.S.,

Chevalier of the Legion of Honour,

FORMERLY PRESIDENT OF THE SOCIETY OF CHEMICAL INDUSTRY,

Vice-President of the Chemical Society and of the Institute of Chemistry,

DEPARTED THIS LIFE IN THE 53RD YEAR OF HIS AGE.

A LOSS DEEPLY REGRETTED BY MANY FRIENDS AND COLLEAGUES.

INTERNATIONAL INVENTIONS EXHIBITION, LONDON.

REPORT ON THE EXHIBITS RELATING TO THE CHEMICAL INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, Manchester, etc.

(Continued from page 483.)

COLOURING MATTERS AND DYES.

ROBERT CHADWICK & SON, OF KIDDERMINSTER (*Group XIV. No.* 1462).

(1.) Improvement in extracting colouring matter and other substances by steam-process from dye-woods; also distillation of ammonia.

(2.) Hygienic crystals and powder disinfectant.

ACIDS, ALKALIS, AND SALTS.

E. C. C. STANFORD'S NEW METHOD OF TREATING SEAWEED (*Group XIV. No.* 1431).

Mr. Stanford's name is intimately associated with the British iodine and kelp industry, the seat of which has always been in Glasgow. The exhibit illustrates generally the manufacture of iodine, bromine, and potassium salts from seaweed, besides that of the new and interesting substance *Algin*, first isolated and studied by Mr. Stanford; also many of the metallic alginates. It would appear that amongst seaweeds, the algæ possess the power of assimilating the iodine from seawater to about ten times the extent of the bromine, and that amongst the algæ the Laminaria and the Fuci are the kelp-producing species of the genus referred to. It is remarkable that the three gelatinous species, Chondrus, Gilideun, and Euchemia contain little or no iodine; moreover, the Enteromorpha or sea-grass, a plant retaining, when dry, a very strong odour of the sea, contains no iodine. The giant algæ growing outside the influence of the Gulf Stream, generally supposed to be the iodine-carrier, singularly enough contain very little iodine. The drift-kelp is made from two varieties of red weeds, or Laminaria, the *L. Digitata* and the *L. Stenophylla*. The former is known as tangle, and both kinds are always submerged. These seaweeds, and especially the latter, are much injured by rain, and are often, after drying, almost valueless. If well preserved, the Laminaria contain ten times as much iodine as the Fuci. It furnishes the only kelp now used for making iodine. The usual yield of kelp from 100 tons of wet seaweed is five tons, and as only half of this is soluble, two-and-a-half tons form the total valuable product of what may be termed the *native process*, and this must pay for the labour of cutting, carrying, drying, and burning 100 tons of wet seaweed. As the people in burning the weed use such a heat as to produce a sort of slaggy mass, and lose thereby about half the iodine, Mr. Stanford proposed the so-called *Char-process*, by which all the iodine is saved. The weed in this process is submitted to destructive distillation in iron-retorts, leaving behind a loose, porous charcoal, retaining the salts and the iodine, and yielding in the distillate, ammonia, acetic acid, and tar. In a still newer process—in fact, the one referred to in the title of the exhibit—Mr. Stanford extracts first the potassium chloride ("muriates"), potassium sulphate and "kelp-salt" (sodium chloride containing some carbonate and including the iodides), by simple maceration in cold water. The amount so removed from air-dried Laminaria is about one-third of its weight (thirty three per cent.), of which twenty to twenty-two per cent. are mineral salts, and the balance consists of dextrin, mannite, and extractive matter, leaving two-thirds of the plant (sixty-six per cent.) for further treatment, apparently unaltered. This residue contains the peculiar new substance *Algin*, and the cellulose. The comparison between the three processes is of considerable interest, as showing the advance made upon the old kelp process so tenaciously adhered to and persisted in by the West Coast natives, by Mr. Stanford's "Char" and "Wet" processes:—

KELP PROCESS.

Per cent. utilised, 18.

Kelp, 18 tons { Salts, 9 tons; Iodine, 270lb. } Residuals—Kelp-waste, 18 tons, valueless.

CHAR PROCESS.

Per cent. utilised, 36.

Char, 36 tons { Salts, 15 tons; Iodine, 600lb. } Residuals—Charcoal, 36 tons, tar and ammonia.

WET PROCESS.

Per cent. utilised, 70.

Water extract, 33 tons { Salts, 20 tons; Iodine, 600lb. } Residuals—Algin, 20 tons, cellulose, 15 tons, dextrin, etc.

In this new process, the seaweed is to be exported and worked at a central factory, and all the common varieties can be used. The weed is first boiled with sodium carbonate, the solution is filtered and precipitated with sulphuric acid, the precipitate being the new substance algin, which resembles albumen, and contains all the nitrogen, and, moreover, all that is nutritive in seaweed. The solution is now neutralised with limestone, the sulphate of lime deposited, the neutral solution evaporated down and the sulphate of soda crystallised out. The mother-liquor, containing all the potash salts and iodine, is carbonised, forming the "kelp-substitute." The residue on the filter is the cellulose. The whole plant is thus utilised (see table above).

RESIDUE.	SODA SOLUTION.		
	Precipitated by Sulphuric Acid.	Retained in Solution.	
CELLULOSE.	ALGIN.	Sulphate of Soda, crystallised out as GLAUBER'S SALTS.	Mother-liquor, carbonised, is KELP-SUBSTITUTE.

Algin has fourteen times the viscosity of starch, and thirty-seven times that of gum-arabic. Algin or sodium alginate in solution is precipitated or coagulated by alcohol, acetone, and collodion, but not by ether. It is precipitated by mineral acids, various salts, and by lime- and baryta-water. The solution is not precipitated or coagulated by alkalis and alkaline salts, starch, glycerol, and cane-sugar. It does not precipitate the ordinary alkaloids. It is dis-

tinguished from albumen, which it most resembles, by not coagulating on heating, and from gelose by not gelatinising on cooling, by containing nitrogen, by dissolving in weak alkaline solution, and being insoluble in boiling water. From gelatin it is distinguished by giving no reaction with tannin; from starch, by giving no colour with iodine; from dextrin, gum-arabic, tragacanth, and pectin, by its insolubility in dilute alcohol and dilute mineral acids.

It is remarkable that it precipitates the salts of the alkaline earths, with the exception of magnesium, and also most of the metals, but it gives no precipitate with mercuric chloride or potassium silicate.

Commercial Applications of Algin or Sodium Alginate :—

For Sizing Fabrics.—As a finish, algin has the advantage over starch that it fills the cloth better, is tougher and more elastic, that it is transparent when dry, and that it is not acted on by acids. It imparts to the goods a thick clothy, elastic feeling, without the stiffness imparted by starch. It has the advantage, possessed by no other gum, of becoming insoluble in presence of a dilute acid, which decomposes starch or dextrin. No other gum having anything like the viscosity of algin, in solution, none will go so far in making up the solution or cover such a large surface.

The alginate of alumina in caustic soda, is a stiff dressing, and in the crude, unbleached state, will be a cheap dressing for dark materials; and in the colourless for finer fabrics. *The ammoniated alginate of alumina* can be used to give a glossy surface, which is quite insoluble after drying.

As a Mordant and Dung-substitute in Dyeing and Printing.—Mr. John Christie, of the firm of J. Orr Ewing & Co., states that "there is another application of the alginate of soda—viz., in the fixing of mordants, such as those of alumina or iron upon cotton fibre." Very encouraging results are said to have been obtained, and Mr. Christie believes a very large application will be found for alginate of soda as a "*dung-substitute.*" This being the case, the substitution of so harmless a compound for one so poisonous as the generally used arseniate of soda, should be welcomed, and a fair trial be accorded the new dung-substitute. In Germany, where the use of poisonous materials in connection with printing and dyeing textile fabrics is greatly restricted, if not altogether interdicted, one would imagine such a substitute would, when known, be readily adopted. Mr. Christie continues, "The mordants, when precipitated, seem to have full dyeing power," which means that as a dung-substitute the alginate has done its work well.

As an Article of Food.—Algin contains—carbon, 44·39 per cent.; hydrogen, 5·47; nitrogen, 3·77; oxygen, 46·57, or about the same amount of nitrogen as is found in Dutch cheese. For thickening soups and puddings, as a substitute for gum-arabic in the manufacture of jujubes and lozenges, in making jellies, it is said that it would be very serviceable.

In Pharmacy.—It is said that it would be useful for emulsion of oils, as an excipient for pills, and for fining of spirits.

For Boiler Incrustations.—Mr. Spiller has proved that a solution of sodium alginate forms one of the best fluids for preventing boiler-incrustation, as it quickly precipitates the lime from the boiler water in a state in which it can be easily blown off.

Algic Cellulose :—This substance bleaches easily, and under pressure becomes very hard, when it can be turned and polished with facility. It makes also a good paper, tough and transparent, but with no fibre. Alone or mixed with algin and linseed oil or shellac, it may be used as a non-conductor of electricity, where a cheap material is required.

The Seaweed Charcoal :—It is proposed to use this in conjunction with algin for covering boilers, and such a composition has been largely applied under the name of "carbon cement." This is nearly all charcoal, three per cent. of the algin being sufficient to make it cohere. It forms a cool, light, and efficient non-conducting covering.

The foregoing details have been given somewhat *in extensô*, but the subject is one of those for which the claim of *national importance* can be set up.

Mr. Stanford says, in his paper read before the Society of Arts (May 22, 1884): "No Royal Commission will give the crofters and cottars on the shores of the Hebrides and the West of Ireland anything like the satisfaction that the offer of £1 per ton for all the seaweed they could gather, would. In all these places, the sea-question might soon become more important than the land-question."

The advantages to Proprietors of Shores are that such manufacture would afford an export value to a large waste product at present almost worthless. The export of this bulky material must result in a large traffic to and from the Western Islands, thus improving their rental and value, and assisting in imports of coal, meal, etc.

For Alkali Makers there would also be advantages in such a new manufacture, creating, as it would, a large demand for alkali, bleach, and other chemicals, with some waste products.

Mr. Stanford's process is protected by the following patents :—Eng. Pats. 142, January 12, 1881; and 13,433, October 11, 1884. Also by French Pat. 143,736, July 1, 1881.

The process has been working some time on a semi-industrial scale; all difficulties are successfully overcome, and already there is a considerable demand for the new products.

The following is a list of the more interesting specimens exhibited by Mr. Stanford :—

Alginates.

Sodium	Alginate,	Soluble	
Potassium	,,	,,	
Ammonium	,,	,,	
Lithium	,,	,,	
Magnesium	,,	,,	*(This is a remarkable body; insoluble alginic acid in the presence of water, freely dissolves Magnesia and its carbonate.)*
Calcium	Alginate,	Insoluble	
Barium	,,	,,	
Strontium	,,	,,	
Lead	,,	,,	
Silver	,,	,,	
Mercury	,,	,,	*Mercurous salt, no Mercuric alginate.*
Copper	,,	,,	
Iron	(Ferrous)	,,	
,,	(Ferric)	,,	
Cobalt	,,	,,	
Nickel	,,	,,	
Manganese	,,	,,	

Alginates—*Insoluble.*

Tin	Alginate, Stannic	
,,	,, Stannous	
Zinc	,,	*(Most of the alginates have not yet been described, and the exact composition is unknown.)*
Chromium	,,	
Cadmium	,,	
Bismuth	,,	
Aluminium	,,	
Platinum	,,	
Arsenic	,,	
Antimony	,,	
Uranium	,,	

The following salts are double alginates of the metals with ammonia, and are all very soluble, mostly becoming insoluble when dry, thus forming waterproofing materials:—

Ammonium,	Strontium	Alginate	
,,	Chromium	,,	
,,	Copper	,,	
,,	Iron	,,	Ferric
,,	,,	,,	Ferrous
,,	Tin	,,	Stannic
,,	,,	,,	Stannous
,,	Cobalt	,,	
,,	Nickel	,,	
,,	Manganese	,,	
,,	Silver	,,	
,,	Platinum	,,	
,,	Zinc	,,	
,,	Cadmium	,,	
,,	Aluminium	,,	
,,	Uranium	,,	
,,	Arsenic	,,	
,,	Antimony	,,	

The Aluminium Alginate is also shown in combination with Aluminate of Soda, making a cheap stiff soluble dressing for cotton and other goods, which can be easily rendered insoluble.

Shellac Algin.—Shellac combines with Sodium Alginate, and with Ammonium Alginate, forming a soluble compound of great flexibility; by dipping the sheets of it in a dilute acid or chloride of calcium, these are rendered insoluble, and form a tough membrane resembling gutta-percha, and a good electric insulator.

Calcium Alginate.—A dried block of this substance is exhibited to show its use for ornamental purposes. The sp. gr. is about 1·6, approaching that of ivory.

Insoluble Algin, or Alginic Acid, has a sp. gr. of 1·5, and closely resembles horn.

Algic Cellulose.—A block of this is shown on account of its value for turning purposes; the sp. gr. is about 1·4; higher than that of ebony or lignum vitæ.

Algic Boiler Fluid.—(Already referred to.)

Carbon Closet System.—(See *Chemical News*, vol. xxix. 261 and 284.) A series of specimens is shown to illustrate the application of charcoal to this purpose. The method has been in use for many years in some of the largest shipyards on the Clyde, and has given great satisfaction.

Sewage Filtration.—The specimens shown are historical, having been first exhibited in the Paris Exhibition, 1867.

MESSRS. CHAPMAN & MESSEL (*Group XIV. No.* 1467).

MANUFACTURE OF ANHYDROUS SULPHURIC ACID.

This firm exhibits fine specimens of sulphuric anhydride, which is manufactured on a large scale now with the greatest ease, in the Silvertown works of the firm—thanks to the improvements which were the outcome of the investigations and engineering skill of Drs. W. S. Squire and R. Messel.

Specimens of sulphuryl-monochlorhydrin,

$$SO_2(Cl)OH,$$

and of finely-crystallised 100 per cent. sulphuric anhydride, are exhibited; also a drum made of wrought-iron plate, for packing and carrying the anhydride, is to be seen underneath the show-case. The charging hole of the drum is secured by a kind of screw-stopper, fitting by an appliance known as the bayonet-joint—a simple but powerful means of closing.

Dr. Messel has kindly supplied the writer with some details which are of great interest both for chemist and physicist.

Kohlrausch (*Pogg. Ann. Ergänzungsband*, viii. p. 675) shows that the real hydrate, SO_4H_2, does not present the maximum density of sulphuric acid, as all the tables published had formerly stated, but that water cautiously dropped on the surface of really pure hydrate forms slowly-sinking drops. He found the densities of concentrated acid at 18° C. (water at 4° C. = 1) were:—

Percentage by weight of SO_4H_2.	Specific gravity.
90	1·8147
91	1·8200
92	1·8249
93	1·8290
94	1·8325
95	1·8352
96	1·8372
97	1·8383
98	1·8386
99	*1·8376*
100	*1·8342*

It will thus be seen in the above table that after exceeding the strength of 98 per cent. of SO_4H_2, the acid becomes lower in specific gravity as it further rises in strength to 100 per cent. of SO_4H_2. It has been found by Dr. Messel that an analogous law holds good with regard to solutions of sulphuric anhydride in monohydrated sulphuric acid (SO_4H_2), and that whereas solutions of SO_3 in SO_4H_2, as they increase in percentage of SO_3, likewise increase in specific gravity up to a certain point, after passing that

Specimens.	Percentages of SO_3	Specific Gravity.	Remarks.
—	8·3	1·852 at 60° F. (15·5° C.)	—
Liquid.	30·0	1·940 ,, ,,	—
Crystalline mass resembling nitre.	40·0	1·970 ,, ,,	= 1·956 at 80° F. (26·6 C.) from which the sp. gr. at 60 F. was calculated.
	44·5	1·975 ,, ,,	
	46·2	1·977 ,, ,,	—
—	59·4	1·991 ,, ,,	—
Liquid.	60·8	2·006 ,, ,,	—
	65·0	2·006 ,, ,,	—
	69·4	2·016 ,, ,,	—
Crystallised.	72·8	1·998 ,, ,,	= 1·980 at 87° F.
	80·0	1·973 ,, ,,	= 1·957 at 81° F.
	82·0	1·957 ,, ,,	—

point and attaining a still higher percentage strength in the nearer approach to the condition of the pure anhydride itself, they do not now increase, but diminish in density.

Dr. Messel reserves to himself the right to pursue the investigation, and to repeat his experiments with more stringent scientific exactitude, using absolutely pure materials, so as to gain numbers, doubtless nearly, though perhaps not quite, identical with those hereinafter given.

It will be observed in the exhibit that the specimen cylinders are arranged in a special order, and this the table on previous page will explain, and at the same time the interesting development of a law analogous to Kohlrausch's, will manifest itself.

The 100 per cent. anhydride is crystallised in fine feathery needles. It has been stated that this mode of crystallising is caused by the presence of a trace of water (SO_4H_2), without which it would crystallise like nitre. This, however, needs confirmation. It will be observed in the above table that we have a 30% liquid body, then 40 to 46% crystallised bodies; and at 60 to 69% we have again liquids, a crystalline stage being again and finally reached at 72·8% of SO_3.

Sulphuryl-chlorhydrin, $SO_2Cl(OH)$. — Sulphuric anhydride used for sulphonating organic substances requiring strong treatment, would act too powerfully, and the sudden change of state from the anhydride in the liquefied or fused form to solid sulphonate, in addition to the result of the sudden chemical reaction, causes such a sudden and violent evolution of heat that a considerable portion of the substance is charred. It has been found that by using sulphuryl-chlorhydrin, this tendency to char is prevented, and thus larger yields of sulphonates are obtained, and, moreover, that by its use only one compound is formed, and no isomerides, which is usually not the case when anhydrides are used. The action taking place may be thus explained :—Sulphuryl-mono-chlorhydrin acts on an organic substance capable of yielding sulphonates in such a manner, that whilst sulphonate is formed, hydrochloric acid is simultaneously evolved, and the change of state from $SO_2 {<}^{OH}_{Cl}$ to $SO_3 \mid HCl$, means that the elements of HCl in a liquid substance suddenly unite to form a gas (HCl), heat thus becoming latent. Thus, a large portion of the heat suddenly evolved by the reaction of the SO_3, on the substance sulphonated on the one hand, is simultaneously absorbed in the formation of gaseous hydrochloric acid on the other. This signifies, of course, a kind of cooling process which prevents charring, and so contributes to a larger yield of the sulphonic acid.

Mode of Analysing Specimens of Sulphuric Anhydride.—Two stoppered bottles, containing bulb tubes, with their extremities open and bent in opposite directions, are shown, and these refer to the method adopted by Dr. Messel as the safest and best for easily obtaining in aqueous solution weighed quantities of samples of anhydrides for analysis. A third bottle stoppered up, and containing water along with the sealed bulb of anhydride, illustrates the stage of the operation when a brisk shake is required to break the bulb, the SO_3 going at once into solution in the water.

Fig. 1 represents the bulb tube with extremities bent in opposite directions. Fig. 2 shows the weighed bulb in position for filling itself to any given mark or point in the upper stem, from a bottle containing the anhydride specimen. The bent limb, projecting above the neck of the bottle, is then conveniently situated for closing with the blow-pipe flame. After closing in this manner, the bulb is withdrawn, whilst the extremity is *still warm*, and thus no anhydride can be forced out at the opposite and previously submerged extremity, as the fingers will be cooler than the place touched in the withdrawal from the bottle. Having reversed the position of the extremities of the bulb, the other limb is in like manner closed with the blow-pipe flame, when after cleansing and wiping dry, the bulb is weighed again. It is next cautiously inserted in the bottle (Fig. 3), and gently induced to take the position indicated, some pure water being introduced about the level shown in the cut. The stopper

Fig. 1.

Fig. 2.

Fig. 3.

is then adjusted, and the bottle being taken in the hand is so held that the former is firmly kept in its place. One vigorous shake now suffices to break the bulb in the bottle, and in this there is no danger, only a sudden vibration being felt at the instant the anhydride comes in contact with the water. A white cloud is observed on the sides of the bottle, but by a few gentle shakes a perfect solution is obtained, and after allowing the bottle to cool, it may be opened and the analysis at once commenced. First SO_2, always present to some extent, is determined by titration with iodine solution, and then the SO_3 after precipitation as barium sulphate, though as a rule volumetrically.

A. Boake & Co., London (*Group XIV. No.* 1467).

This firm exhibits a complete collection of products connected with the sulphurous acid industry. Liquefied sulphurous anhydride is a speciality of the firm, and in the glass syphons arranged to deliver either the liquid or gaseous acid as desired, it forms a most convenient preparation for the use of the chemist or photographer. For use in ice-making, brewing, paper-making, disinfecting, bleaching, etc., liquefied sulphurous anhydride is also exhibited in copper drums, containing 1 and 2 cwt. respectively. A very complete set of sulphites is exhibited, many of these being but little known, and some entirely new. Amongst these sulphites the following specimens deserve special notice :—

Sodium sesqui-sulphite, $Na_4(SO_3)_3.9H_2O$. Fine white needles.

Chromium sulphite, $Cr_2.3SO_3$. Beautiful transparent green crystalline mass.

Cuproso-cupric sulphite, $Cu_2SO_3,CuSO_3,2H_2O$. Mass of glistening small needles, of a rich brown colour.

Ammonium sulphite, $(NH_4)_2SO_3$. White prisms.

Lithium sulphite.

Uranium sulphite, $Ur_2,3SO_3$. Beautiful orange yellow crystalline mass.

Nickel sulphite, $NiSO_3.6Aq$. Fine green tetra-hedra.

A new salt, meta-sulphite of potassium, is exhibited in the form of fine large and sharply-defined crystals. It will probably find considerable application in the arts, seeing that it contains nearly 60 per cent. of SO_2, and is at the same time perfectly stable, neither oxidising nor evolving sulphur dioxide on exposure in the air. The ammonio-cuproso sulphite is a singular copper salt, being perfectly white, and crystallising in small white pyramids.

The sulphites at present of greatest industrial value are well represented by sodium sulphite, crystallised

and anhydrous; bisulphite of sodium, solid and in solution, sulphite and bisulphite of magnesium, and sulphite and bisulphite of calcium.

JAMES HARGREAVES, WIDNES (*Group XIV. No.* 1467).

HARGREAVES AND ROBINSON'S PATENT PROCESS FOR MANUFACTURING SULPHATES OF SODIUM AND POTASSIUM.

A model of the Hargreaves plant is shown, and it exhibits in a clear and instructive manner the arrangement of a piece of chemical apparatus, perhaps as difficult as any to explain the working of by means of plans or diagrams.

The Process.—Common salt mixed with ground rock salt is moulded into oblong cakes and placed in large iron cylinders 18 to 24ft. in diameter and 12ft. deep. Sulphur dioxide from burning pyrites, together with air and steam, is caused to pass *downwards* through the cylinders so charged, in succession, commencing with the strong gas on the most nearly finished sulphate, and is thus absorbed in its passage. At the same time, the common salt during its conversion is evolving hydrochloric acid, which is subsequently condensed and used for manufacturing bleaching powder.

The cylinders are encased in brickwork, and a small fire supplies the heat necessary to maintain the contents of the cylinders at a uniform working temperature. Theoretically, the heat set free during the process should be sufficient to maintain itself and keep the process going. In the best-designed and larger forms of plant, such as that of Messrs. Sullivan & Co., the British Alkali Works, Widnes, this is actually being done, so that once in working order practically no more fuel is required and the small fire-places are simply closed.

JAMES MACTEAR, GLASGOW (*Group XIV. No.* 1467),

Exhibits (1.) Working model of the Mactear carbonating or calcining furnace, with three large diagrams, giving different views of the furnace; (2.) Two large photographs of the mechanical salt-cake furnace; and (3.) Specimens illustrating the Mactear process for recovering sulphur from alkali waste drainage.

A very full description of the mechanical calcining and salt-cake furnaces will be found in this Journal, vol. i. 26 to 32.

MACTEAR PROCESS FOR RECOVERING SULPHUR FROM ALKALI WASTE DRAINAGE.

The drainage liquor, or, as it is termed, "yellow liquor," of the vat waste-heaps, else running into brooks and other water-courses, sewers or drains, and making the first unsightly and unwholesome, and the latter noxious, is treated with a solution of sulphurous acid. The sulphur dioxide obtained from pyrites or from the refuse sulphur of the process, is led into condensing towers built of wood, and bound with iron corner-pieces and tie-rods. Each tower is divided into three stages by means of strong cross-joists, and is then filled with cokes. A tray, with a large number of little tubes of lead covered over with lutes to avoid entrance of air, divides the water into fine streams, and the sulphurous acid gas is then led up one tower, down to the bottom, then up another tower, and so on in succession. The solution of sulphurous acid, in practice, has a specific gravity of only about 2° T. This solution is led, by means of a wooden shoot, to the decomposing vessels, and is mixed on its way with a stream of the yellow liquor; the liquid then runs into the decomposing vessel, where it is met by a stream of hydrochloric acid, and the whole is kept carefully at as near 145° F. as possible. With moderate care little sulphuretted hydrogen is evolved, and the decomposition is regulated by the following method of testing:—A burette being fixed to a wooden upright and filled with the yellow liquor, a sample is drawn from the decomposing vessel, a drop of solution of ferrous sulphate is added, and then the yellow liquor run in from the burette. The number of divisions required to blacken the solution indicates the acid still present.

The sulphur is allowed to settle, and the clear liquor run off through a catch pit, so as to retain any sulphur that might be otherwise lost. After some five or six operations, the sulphur sludge is run off into a drainer. After draining into a stiffish mud, the latter is melted by steam in a suitable vessel, the arsenic being removed by an application of the fact that alkaline sulphides dissolve sulphide of arsenic.

DETAILED COST OF ONE TON OF SULPHUR BY THE "MACTEAR" PROCESS.

	CWT.	QR.	LB.	RATE.	COST.
Pyrites Sulphur	8	0	25	39/-	16·03s.
Salt	35	1	18	16/-	28·33
Vitriol	29	3	27	30/-	15·00
Coal	111	2	7	41/-	25·20
Repairs	..	..	..	..	4·00
Wages	..	..	..	..	38·50
					157·06
Off Sulphate of Soda	39	0	21	49/-	96·01
Net cost of one ton of Sulphur	..	..	..	..	61·05s.

In the above nothing is charged for hydrochloric acid.

When the "yellow liquors" are very weak, say of specific gravities 5° to 8° T., instead of 11° T., the sulphurous acid solution is replaced by a stronger liquor. This is obtained by preparing a solution of sulphite of calcium in sulphurous acid. The sulphite of calcium is obtained, in a crude form, from old alkali waste-heaps. The oxidised waste is ground with water to a milk, and this is treated with sulphurous acid. More hydrochloric acid is, of course, ultimately required in this latter process.

About 16,000 tons of sulphur have, so far, been made by the Mactear process, as Mr. Mactear informs the writer.

In the exhibit are shown specimens of the hydrochloric acid, of soda waste, and of the clear and perfectly innocuous liquor, free from sulphuretted hydrogen, which is finally run off. Also specimens of sulphur precipitate used for vine dressing, and of rock sulphur obtained by fusion. A bottle contains a mixture of sulphurous acid and "*bog liquor*," as the drainage liquor is termed at St. Rollox, just ready for decomposition, whilst a specimen in another bottle shows the sulphur as precipitated from the mixed liquid by hydrochloric acid.

LUDWIG MOND, LONDON (*Group XIV. No.* 1467)

RECOVERY OF SULPHUR FROM ALKALI WASTE.

There is not the least doubt that this process can be worked even at the present time to profit; in fact, the firm in which Mr. Mond's experiments were first carried out in this country, and for which he first erected plant, still continues the process, and not only utilises its own waste, but some of that from adjoining works. At the first, it was proposed in this process to treat the alkali waste left after lixiviating the black-ash, in the same vats, blowing in air under the false bottoms, so that it should ascend

through the superincumbent mass of waste. This did not seem to answer, and separate vats were afterwards constructed for blowing the waste, the latter being carried from the black-ash to the oxidising vats in tram waggons. Even with Mond's process, a final waste is obtained which does still contain sulphur as calcium sulphide to the extent of somewhat under one-fourth of the original total sulphur as sulphide; but, before getting this extracted, the manufacturer is confronted with two questions, the answers to which, in the ordinary course of working, conspire to give a flat negative to the attempt. The one is, What time would be expended in blowing and oxidising this last residual of sulphide so as to render the sulphur available? and, Would it be profitable, with plant and vat space at disposal, to sufficiently protract the oxidising operations, considering the vast bulk of the material dealt with generally, and specially with regard to this final residuum of sulphide? Dr. Schäppi has, however, shown in an able paper (see this Journal, vol. i. 482—486) that by blowing oftener, and by adopting other precautions, considerably more sulphur can be extracted than usually is, and that if the waste after repeated oxidation and lixiviation could be *prevented from hardening*, more sulphur still could be extracted. This is a difficulty that might possibly yet be overcome as the result of further investigation and experiments. The first patents were taken out in 1862 and 1863, and a small pamphlet now before the writer, and published by Mr. Mond in 1868, gives an interesting account of the theoretical and practical bearings of the process. Another pamphlet published by him in 1870, gives an interesting statistical view of the subject, "Of the Probable Effect of the General Adoption in Great Britain of Mond's Process for the Recovery of Sulphur from Alkali Waste from a Mercantile Point of View, being a Paper communicated to the River Pollution Commissioners at their request." At that time and previously, vat waste was carelessly tipped and packed in the waste-heaps, and gave vent to copious noxious emanations, both gaseous and liquid, and on the other hand, much hydrochloric acid was allowed to run away, especially weak acid from the wash-towers. If it will pay *now* to work Mond's process (and the writer was informed by the manager of one firm in Lancashire that the best profit of a recent year of his firm was made by sulphur recovery), it is hard to avoid the conviction that Mr. Mond was not far from the truth *then*, as to realisable actualities, when he stated that "the total cost of manufacturing 40,000 tons of sulphur being £80,000 a-year, a clear profit of £160,000 a-year would then have been obtainable." Mr. Mond's exhibit includes a coloured diagram of plant for lixiviating black-ash, and for the recovery of sulphur from the vat waste. Samples are shown (1) of fresh alkali waste; (2) of spent alkali waste, the residue of the Mond process; (3) of hydrochloric acid, the condensate of the salt-cake process. (4.) The "yellow liquor," containing principally hydrosulphide, polysulphides, and thiosulphate of calcium; (5) precipitated sulphur liquor—*i.e.*, after treatment in the agitator with hydrochloric acid. (6.) Wet and freshly-precipitated sulphur. (7.) The fused and finished sulphur as put in the market.

Messrs. Gaskell Deacon & Co., Widnes (*Group XIV. No.* 1467).

The exhibits refer to (1) Deacon's chlorine process with Hurter's improvements, and (2) the manufacture of monohydrated carbonate of sodium, "crystal carbonate," and of bicarbonate of soda by Hurter and Carey's processes.

1. *Deacon's Chlorine Process.*—Excellent coloured diagrams are shown, illustrating a Deacon's chlorine cylinder (superheater and decomposer), with specimens of the baked clay balls saturated with cupric chloride, and a Deacon's shelf bleaching powder chamber, with a specimen of the bleaching powder produced from chlorine which has been generated from hydrochloric acid gas, dried by passing it through the heated cupreous clay balls contained in the Deacon cylinders. With this interesting process, the name of Dr. Ferdinand Hurter is intimately connected. To his admirable paper, "On the Prospects of the Manufacture of Chlorine" (this Journal, vol. ii. 103—109), those specially interested in a study of the question are referred.

2. *Manufacture of Monohydrated Carbonate and Bicarbonate of Soda.*—The investigations and experiments of Hurter have led to the possibility of obtaining in one process what would have previously required at least three to effect, and now in place of the so-called "black salts," as the impure monohydrated carbonate salts, obtained by the evaporation of the black-ash lixivates, are termed, Messrs. Hurter and Carey obtain directly, by evaporation, a pure white crystalline salt, of which Messrs. F. Steiner & Co., the great Turkey-red dyers of Lancashire, declare, "It is the purest form of sodium carbonate in the market," and that, "dissolving readily in water, with a slight evolution of heat, it has thereby an advantage over soda-crystals and soda-ash."

It is well known that the small quantities of iron in soda-ash are derived from cyanides formed in the black-ash process, the nitrogen of these being practically the nitrogen of the coal used in the black-ash mixture, and that on lixiviation in contact with the iron of the vats, ferrocyanides are formed. The monohydrate salts, eventually roasted for the production of soda-ash, retain mother-liquor containing these ferrocyanides, besides some sodium ferrosulphides, and these compounds on roasting decompose, leaving behind ferric oxide. By Hurter and Carey's process, the liquors are first well carbonated by black-ash furnace gases or otherwise. The sulphides in them are also, to a certain extent, oxidised to thiosulphates by the addition of oxidising agents. The silica and alumina in solution are precipitated in the carbonating process, and are separated by settling and subsequently running off the supernatant liquor. By forcing this liquor through a coil of pipe against a loaded valve, the coil being heated by a superheater, so that at least a temperature of 177° C. is attained, the ferrocyanides in presence of the thiosulphates are decomposed with formation of ferrous sulphide, which afterwards is easily separated by allowing the liquors to stand in large settlers. The clear liquors drawn off, on evaporation, yield the pure white "crystal carbonate." See Eng. Pats. 2939, July, 1879; and 608, February, 1880. (This Journal, vol. i. 26—27.)

Ordinary soda-ash roasted in brick furnaces, may contract minute quantities of alumina from the brickwork in addition to that derived from the black-ash mother-liquors, besides containing the small quantities of iron arising from the ferrocyanides, as already mentioned. When soda-ash is used by the dyer or calico-printer, the ash is usually dissolved by steaming in a pan, and is afterwards allowed to settle to deposit any insoluble matters containing iron and alumina, the clear supernatant liquor being eventually used. However, in some cases, the desired settling is not quite effectual, and either iron or alumina in but minute particles on the fibre may, in the case of certain light and bright shades, cause slight but objectionable modifications of colour to develop in

spots or patches. It is plain that the crystal carbonate containing absolutely no alumina or iron, is free from the defects named, and furnishes immediately a pure liquor likewise free from the least causticity, a desideratum with woollen bleachers. The following are analyses of "soda-crystals" and of "crystal carbonate":—

	Soda Crystals. %	Crystal Carbonate. %
Carbonate of soda	34·22	82·90
Hydrate of soda	0·10	0·00
Sulphate of soda	2·54	trace
Chloride of sodium	0·27	trace
Water	62·84	17·00
	99·97	99·90
Total soluble impurities (water excepted) on 100 of carbonate	8·21	0·12
Water on 100 of Carbonate	183·64	20·50

Solubility.—*Soda-crystals* are soluble in cold water with difficulty, because—

1stly. Being in large lumps, they offer but little surface to the action of the water.

2ndly. By solution they *lower* the temperature of the water, *122 units of heat* being *absorbed.*

Crystal Carbonate dissolves in cold water with the greatest ease, because—

1stly. Consisting of minute crystals, it offers immense surface to the action of the water.

2ndly. By solution it *raises* the temperature of the water, *35 units of heat being evolved.*

One ton of crystal carbonate contains as much alkali as 48cwt. of soda-crystals.

Storage.—48cwt. of soda-crystals packed in 24 2-cwt. barrels, occupy about 150 cubic feet. One ton of crystal carbonate packed in casks, holding from three to four cwt. each, occupies about 65 cubic feet.

The Bicarbonate of Soda is prepared from the "crystal carbonate" by exposing the latter in an iron revolver, resembling closely a miniature black-ash revolving furnace, to the action of moist carbonic acid gas. Heat is evolved, and the cylinder becomes so hot that were a small quantity of bicarbonate of soda placed in contact with the metal outside, it would suffer slight decomposition. Nevertheless, the bicarbonate formed in the interior of the revolver is not decomposed in the slightest, because of the presence of the surrounding atmosphere of carbonic acid in which it is generated. It goes without saying that the employment of so pure a material as the "crystal carbonate," ensures the production of an extremely pure bicarbonate, and since no water escapes during the process, there is no loss of material carried off in solution, and so the process is one purely of conversion *in sitû.*

James Muspratt & Sons, Widnes (*Group XIV. No.* 1467).

MUSPRATT & ESCHELLMANN'S PATENTS FOR MAKING CHLORATE OF POTASSIUM AND CHLORATE OF SODIUM.

(Eng. Pats. 3960, Aug. 15, 1883; 5183 and 5186, Oct. 31, 1883. This Journal, vol. iii. 349 and 445.)

In the patented process, magnesia is substituted for lime for the absorption of chlorine, and subsequent treatment of the liquors obtained, so as to increase the production of chlorate.

Rationale of the Process.—In the ordinary process a large quantity of chlorate of potassium is held in solution by the chloride of calcium of the mother-liquor. $KClO_3$ is much less soluble in magnesium chloride solutions than in those of calcium chloride, and consequently much less chlorate is kept in solution by the magnesium chloride.

The usual proportion of chlorate to chlorides in the liquors obtained by the absorption of chlorine is 1 : 5; but by crystallising out nearly 50 per cent. of the magnesium chloride, before adding the KCl, the quantity of mother-liquor becomes considerably reduced. This, together with the less solubility of $KClO_3$ in the magnesium chloride liquor, increases the production of chlorate in the new process by from 15 to 20 per cent.

The mother-liquor itself (magnesium chloride) is, after proper treatment, for which patents have also been obtained, a valuable by-product.

For the production of chlorate of sodium, the improved liquor containing chlorate and cloride of magnesium is used, in the proportion of about 1 : 3. This liquor is precipitated by carbonate of soda or caustic soda; the filtrate, containing chlorate of sodium and chloride of sodium, is evaporated and the salt separated by fishing; the remaining liquor crystallises, yielding a salt which, after a second crystallisation, is pure chlorate of sodium. The precipitated carbonate of magnesia can be sold as such, or calcined, and the magnesia used over again.

In the Exhibition a diagram is shown, displaying the apparatus used in Muspratt and Eschellmann's process for the manufacture of potassium and sodium chlorates, and, besides this, specimens illustrating the various stages of the processes, as follow:—

1. The improved liquor.
2. The octagon liquor.
3. The neutralised liquor.
4. The chlorate of potassium mother-liquor.
5. Ground potassium chlorate.
6. Potassium chlorate. First crystals of the process
7. Potassium chlorate. Finished crystals.
8. Calcined magnesite, ground.
9. Calcined magnesite (magnesia), unground.
10. Native magnesite in lumps.
11. Magnesium chloride in crystals. } Looked beautifully white and pure.
12. Magnesium chloride in crystalline lumps. }
13. Sodium chlorate. First crystals and greyish.
14. Sodium chlorate. Finished crystals, in size about that of small beans. } Look very white and pure.

Chlorate of sodium ($NaClO_3$) is largely used for aniline black in calico printing, being far more easily soluble than potassium chlorate.

Joseph Gamble and Sons, St. Helens (*Group XIV. No.* 1467).

MANUFACTURE OF CHLORATE OF SODIUM.

Messrs. Gamble & Sons employ M. Pechiney's patented process. See this Journal, vol. i. 41.

Specimens are shown of—

1. Barium chlorate ($Ba(ClO_3)_2 + H_2O$) Small crystals.
2. ,, ,, in medium size crystals; and
3. ,, ,, in large crystals.
4. Sodium chlorate, in fine, medium and large crystals.

There are exhibited, besides, remarkably fine crystals of sodium sulphide, $Na_2S + 9H_2O$. These are large and transparent, with a faint brownish tinge, and resemble in appearance crystallised sodium acetate. This sodium sulphide is manufactured at Messrs. Gamble's Works, by Schaffner and Helbig's patent process

*MR. W. WELDON, F.R.S., OF BURSTOW (*Group XIV. No.* 1467).

1. PROCESS FOR MANUFACTURING CHLORINE BY MANGANITE OF CALCIUM.

2. PROCESS FOR MANUFACTURING CHLORINE FROM CHLORIDE OF MAGNESIUM.

Mr. Walter Weldon, F.R.S., exhibits a model of the apparatus employed in the well-known process for the manufacture of chlorine which bears his name, and specimens illustrating the different steps in that process. In 1862, except in a single work, chlorine was universally manufactured by digesting together aqueous hydrochloric acid and ores of manganese; and the residual mixed solution of manganese chloride, ferric chloride, and free hydrochloric acid was always sent into the nearest water-course. The manganese employed in the manufacture of chlorine was thus used only once, and was then thrown away as one of the constituents of a most offensive solution, alike poisonous to fish, and extremely destructive to any masonry or ironwork with which the stream into which it was thrown might come into contact. The problem of how to avoid this loss of the most costly reagent employed in the chlorine manufacture, and at the same time to prevent the nuisance occasioned by that manufacture, had long engaged attention, and the late Mr. Dunlop, of Glasgow, had worked out a process accomplishing these objects, which process was in operation in one factory, that of St. Rollox. The Dunlop process, however, never extended beyond that one factory, and even there, so far as the regeneration of manganese for use again in the manufacture of chlorine is concerned, it is now replaced by the Weldon process, though it is still employed for the production of an artificial oxide of manganese for use by glass-makers and others. Mr. Weldon took up the problem of the regeneration of MnO_2 from $MnCl_2$ in 1866. Chlorine began to be manufactured by means of "Weldon mud" about 1870, and it is now years since an ounce of manganese ore was anywhere employed in the manufacture of chlorine, except to make up unavoidable mechanical loss in the Weldon process. There is no other instance of the old-established methods of a great chemical industry having been completely revolutionised within so brief a period. There are four works in this country and two on the Continent in which chlorine is manufactured by the Deacon process. In the four English works, the two-thirds or so of the HCl treated by the Deacon process, which escapes decomposition in that process, is subsequently treated by the Weldon process. In the two Continental works in question, that HCl is condensed into aqueous acid for sale, and those two works are the only chlorine works in the world in which the Weldon process is not employed.

The residual products of the manufacture of chlorine by the Weldon process is a mixed solution of manganese chloride and calcium chloride, containing also a little free hydrochloric acid. The latter having been neutralised by limestone, milk of lime is added to the neutralised liquor in such quantity that the product is a solution of calcium chloride holding in suspension manganese hydrate and calcium hydrate, in the proportion of one equivalent of the former to six-tenths of an equivalent of the latter. Into this mixture, which is a thin white mud, air is then injected, until about 80 per cent. of the manganese present has become converted into MnO_2. The absorption of oxygen from the injected air takes place very rapidly; in large "oxidisers," as the vessels in which the operation is performed are called, more than a hundredweight of oxygen being absorbed per hour. The product is a thin black mud, in which four-tenths of the manganese present is in the state of $MnMnO_3$, and six-tenths of it in that of $CaMnO_3$, or a compound of MnO_2 with CaO. It is upon the formation of this compound that the Weldon process depends. When manganese hydrate is treated by oxygen in the wet way, the MnO_2 which forms must combine with a base at the moment of its formation. If the only base present be manganous hydrate, the MnO_2 formed by the combination with oxygen of a portion of the hydrated MnO combines with the other portion of that MnO, forming either normal manganite of manganese, $MnMnO_3$, being a compound of one of MnO_2 with one of MnO, or Mn_3O_4, being a compound of one of MnO_2 with two of MnO, according to the temperature employed. Thus, when MnO is the only protoxide present, one-half is the maximum proportion of it which can be converted into MnO_2, the other half of the MnO being required to furnish the necessary base for that MnO_2 to combine with. If, however, with the manganous hydrate which is treated by oxygen in the wet way any one of a certain number of soluble protoxides be present, the MnO_2 which forms combines with that soluble protoxide instead of combining with MnO; and thus, if the quantity of soluble protoxide present be a full equivalent, the whole of the manganese present may be converted into MnO_2. But to convert the whole of the manganous hydrate treated, into MnO_2 combined with CaO, would of itself have no advantage to the manufacturer of chlorine, over the conversion of only half of it into MnO_2, the half of it converted into MnO_2 being combined with the other half of it as $MnMnO_3$: since calcium manganate liberates from hydrochloric acid only the same proportion of its chlorine as is liberated therefrom by manganese manganite, as is seen from the two equations—

$$MnMnO_3 + 6HCl = 2MnCl_2 + 3H_2O + 2Cl \text{ ; and}$$
$$CaMnO_3 + 6HCl = CaCl_2 + MnCl_2 + 3H_2O + 2Cl.$$

The advantage of forming calcium manganite instead of manganese manganite lies chiefly in this, that the absorption of oxygen by manganous hydrate, in the presence of dissolved lime, is enormously more rapid than the absorption of oxygen by manganous hydrate in the absence of a soluble base. To such an extent is this the case, that while, per given quantity of MnO_2 in each respectively, Weldon mud is very much cheaper than native manganese, the product of the treatment by oxygen of manganese hydrate only, would be very much more costly than native manganese.

To convert into calcium manganite the whole of the manganous hydrate treated, would require the presence therewith of a full equivalent of calcium hydrate; but so large a proportion of calcium hydrate cannot be employed industrially, because there cannot be present sufficient calcium chloride to hold it in solution. Hence, only enough calcium hydrate is used to convert 0·6 of the manganese present into manganite of calcium. The other 0·4 of the manganese present is converted into manganite of manganese.

When 60 per cent. of the manganese present in a Weldon oxidiser has been converted into $CaMnO_3$, and the other 40 per cent. of it into $MnMnO_3$, a

* The following account was forwarded to the writer of this report by Mr. Weldon two or three months ago. It is printed word for word as written in the manuscript, in accordance with a wish expressed in a letter received at the same time from Mr. Weldon. It is somewhat remarkable that this the last contribution from his pen for this Journal, is the account of the great work of his life—written with characteristic care, and in that inimitable style peculiar to him whether writing or speaking, which rivets the attention alike of reader and hearer. It is very remarkable that it should be timed to appear in that number of this Journal which also contains the brief notice that his life's work is done.

further quantity of neutral solution of $MnCl_2$ and $CaCl_2$ is sent into the oxidiser, and the injection of air is continued. At the temperature employed $MnCl_2$ can react upon half the lime of normal calcium manganite, the products being manganous hydrate and a compound of two of MnO_2 with one of CaO. The manganous hydrate becomes oxidised, partly into $MnMnO_3$, partly into Mn_3O_4, the final product being a thin black mud consisting of solution of calcium chloride holding in suspension a mixture of manganites of manganese with an acid manganite of calcium, which mixture can liberate more than two equivalents of chlorine from six of HCl. This product is then run into settlers, in which it separates into clear solution of calcium chloride and a denser mud. The former is then decanted, and the latter run into stone stills which have previously been charged with aqueous hydrochloric acid.

While this process has completely superseded the old method of manufacturing chlorine, and, as Dumas put it, has "cheapened every sheet of paper and every yard of calico used in the world," saving to the community hundreds of thousands of pounds per annum, besides enabling the manufacture of chlorine to be carried on without causing nuisance, and ameliorating the lot of the workmen engaged in that manufacture, who have now simply to manipulate a few cocks and valves, its inventor believes that it is about itself to be superseded. He exhibits also some illustrations of a process for the manufacture of chlorine, which is performed in the dry way, in which manganese is not employed, and which, while it is applicable to the manufacture of chlorine from the hydrochloric acid produced in the Leblanc process, may also prove capable of enabling chlorine to be manufactured in connection with the manufacture of soda by the ammonia process. At present the ammonium chloride of the ammonia-soda process is decomposed by lime, and the chlorine of the salt decomposed by that process is thus finally obtained as calcium chloride, and in that state is thrown away. In 1872 M. Solvay and Mr. Weldon simultaneously proposed to decompose that ammonium chloride by magnesia instead of by lime, and to treat the resulting magnesium chloride for the obtainment of its chlorine as hydrochloric acid. * Neither M. Solvay nor Mr. Weldon, however, succeeded in rendering the decomposition of NH_4Cl by MgO industrially practicable; and it is only quite recently that it has been rendered so by MM. Pechiney & Co., Salindres. Moreover, the manipulation of large quantities of magnesium chloride was found to present great difficulties, which for many years seemed insuperable. Mr. Weldon's continuous experiments on the subject at length led him to the idea of converting the magnesium chloride into solid infusible oxychloride, before attempting to drive off its chlorine as HCl; and it was then found that if the oxychloride were heated in a current of air, a large part of its chlorine was evolved in the free state. Mr. Weldon failed to devise apparatus in which this operation could be conducted industrially, but suitable apparatus for it has now been invented by M. Pechiney, in conjunction with the engineer of Salindres, M. Boulouvard. As this apparatus is not exhibited, it need not be here described.

The starting point of the new Weldon chlorine process is magnesium chloride, which may be obtained either by neutralising aqueous hydrochloric acid by magnesia, or by decomposing by magnesia the ammonium chloride of the ammonia-soda process, or may be magnesium chloride from any other source. To a hot saturated solution of it free magnesia is added, and there is thus obtained a solid hydrated oxychloride, containing six equivalents of water. This is heated to a low temperature, until a large part of its water has been driven off. The residue is then heated to a high temperature in a current of air, when half its chlorine goes off in the free state, and half as vapour of HCl, magnesia only remaining behind. The proportion of the chlorine of the oxychloride which goes of in the free state is thus 50 per cent. greater than the proportion of free chlorine obtained by the old Weldon process from an equivalent quantity of hydrochloric acid, and that part of it which does not go off in the free state, instead of being lost as $CaCl_2$ is yielded as HCl, available either as raw material from which to manufacture more chlorine, or for use for any other purpose. The development of this process will be watched with great interest, since its success, by enabling the chlorine of the salt used in the manufacture of ammonia soda to be obtained in the free state, would take away from the Leblanc process its only remaining support.

* In that last letter received by the writer from Mr. Weldon, and accompanying this communication, he states: "Except that I could not but take the opportunity of making some explanations of some points in respect of the old Weldon process which are frequently misunderstood, the only part of the enclosed which I really care about is that part of it which gives to M. Pechiney and M. Boulouvard the credit due to them in respect of the new chlorine process."

Messrs. Brunner, Mond & Co., Limited (*Group XIV. No.* 1467).

THE AMMONIA SODA PROCESS (SOLVAY AND MOND).

This firm exhibits a large photo-lithographed picture of the Winnington Works, near Northwich.

Moreover, specimens are shown illustrating the different steps in the ammonia-soda process—viz.:—

(1.) The natural brine.

(2.) Ammoniacal brine before carbonating under pressure.

(3.) Carbonated ammoniacal brine.

(4.) Crude bicarbonate of soda.

(5.) Sesquicarbonate of soda.

(6.) Refined bicarbonate of soda (Mond and Jarmay's process. Eng. Pat. 2996, February 9, 1884. This Journal, iv. 282).

(7.) Monocarbonate of soda.

(8.) Pure alkali (unground).

(9.) Pure alkali (ground).

Messrs. Brunner, Mond & Co.'s Works were established in 1873, and are now producing 7000 tons of carbonate of soda per month. The extension of the works now in progress will raise their producing power to 10,000 tons per month.

The patents of Mr. Ernest Solvay, of Brussels, are being worked by this firm, together with various improvements patented by Mr. Ludwig Mond.

Although the chemistry of the ammonia-soda process was fully described in a patent taken out in England in 1838 † by Messrs. Dyar and Hemming and although several practical manufacturers of the highest standing, amongst others, James Muspratt, James Young, William Gossage, and Henry Deacon, had devoted time, energy, and capital to its realisation, it was considered incapable to compete with its rival the Leblanc process, until Mr. Ernest Solvay made it an industrial success, by the apparatus which he invented, and the indomitable energy and perseverance with which he worked out the details of the process. Mr. E. Solvay is therefore justly considered the founder of the ammonia-soda industry.

Mr. Ludwig Mond took a licence from Mr. Solvay in 1872, which was subsequently transferred to Messrs. Brunner, Mond & Co. At that time the works which Mr. Solvay had established at Couillet,

† "The Manufacture of Carbonate of Soda." Harrison Grey Dyar and John Hemming. Eng. Pat. 7713, June 30, 1838.

in Belgium, produced about ten tons of carbonate of soda per diem in two separate sheds. Under Mr. Solvay's guidance Mr. Mond designed plans for carrying out Mr. Solvay's process on a larger scale, according to which works were erected in Winnington in 1873. These works proved capable of producing 20 tons per diem, per element of plant. They were started early in 1874, and were the first works in which carbonate of soda was manufactured from natural brine.

When in 1881 it was decided considerably to extend the works at Winnington, Mr. Mond designed plant upon a much larger scale. Some of the apparatus used was increased in size, but a great part of the plant was constructed according to Mr. Mond's own patents, and entirely different from that hitherto in use.

Each element of this plant produces 60 tons of carbonate of soda per diem, and thus effects a great saving in labour, repairs, and first cost, as compared with the older plant.

Messrs. Brunner, Mond & Co. also exhibit refined bicarbonate, made by Mond and Jarmay's process.

The bicarbonate made by the ammonia-soda process contains a certain quantity of ammonia which cannot be got rid of by washing, and makes the product unsuitable for the market. Messrs. Mond and Jarmay dissolve this bicarbonate in warm water and pass the clarified solution in a constant stream through a series of cooling tanks. In these a pure bicarbonate of soda is deposited in small crystals. These are from time to time removed, passed through a hydro-extractor, then dried and dressed as usual.

All the ammonia remains in the mother liquor, which is used many times over, and is then treated for the recovery of the ammonia.

MESSRS. BELL BROS., LIMITED, MIDDLESBROUGH (*Group XIV. No.* 1467).

THE AMMONIA-SODA PROCESS (SCHLOESING).

The patents worked by Messrs. Bell Bros. were taken out by Sidney Pitt (communications from J. J. T. Schloesing) on May 28, 1878, and May 4, 1882, entitled, "Improvements in the Manufacture of Carbonate of Soda by the Ammonia Process," and numbered respectively 2130 and 2110.

The essential difference between Solvay's and Schloesing's processes is that in the former, ammonia and brine are treated together with carbonic acid under pressure; whilst in the latter ammonia is carbonated as *one separate step* of the entire process, and the small crystals of bicarbonate of ammonia precipitating are used in a *second step* to mix with brine in an agitating vessel, so as to yield bicarbonate of soda.

Messrs. Bell Bros., Limited, exhibit the following specimens :—

(1.) The bicarbonate of ammonia representing the first step of the process.

(2.) The bicarbonate of soda produced by mixing the ammoniacal salt with brine, and

(3.) The finished product.

Messrs. Bell Bros. have only somewhat recently started, and they are now manufacturing about 200 tons of alkali per month.

For a full account of the origin of the ammonia-soda process, see Mr. Mond's interesting paper commencing on this page.

THE EGLINTON CHEMICAL CO., LIMITED, GLASGOW (*Group XIV. No.* 1441).

The manufactures of this firm are represented by the following exhibits :—

(1.) *Chromate Leather*, tanned with bichromate of potash, etc.; produced in one-fifth the time of ordinary tanned leather, and at less than half the cost. It is said to be much more durable than ordinary leather, and thoroughly waterproof. Suitable for all purposes of the ordinary article, and particularly for use in the army and navy, for shooting, fishing, and football boots, hydraulic and pump leather, and for butling purposes.

(2.) *Patent Bichromate of Soda*, as a substitute for bichromate of potash, containing as much chromic acid as bichromate of potash, and saleable at about £10 per ton under the price of bichromate of potash. Samples of chromate and bichromate of lime and of alumina are also exhibited.

(3.) *Silica Bricks*, made from pure flint. Practically free from iron; more refractory and less expansive under intense heat than Welsh Dinas bricks, or any other form of silica brick. Specially suited for lining steel and iron heating furnaces, arches of gas retorts, etc., etc.

(*To be continued.*)

Communication.

ON THE ORIGIN OF THE AMMONIA-SODA PROCESS.

BY LUDWIG MOND.

ALL writers on this subject from Brande in 1841 * to Lunge † in 1880, fix the date of this invention at the 30th of June, 1838, when Messrs. Harrison Grey Dyar and John Hemming, both chemists of London, filed the petition for their English patent. Only of recent years an attempt has been made by several French savants ‡ to put the date of the invention sixteen years later, in order to claim it as a French invention and to give the credit of it to two of their countrymen, Messrs. Schloesing and Rolland, who took out a patent relating to the subject in 1858, preceded by a patent taken out by Mr. Schloesing alone in 1854.

It would seem superfluous to contradict an error so palpable and so easily refuted by reference to documents accessible to everyone, had not this statement been made by three scientific men of the highest standing, whose name is sufficient to obtain acceptance for it by numbers who have not themselves inquired into the facts.

In justice to Messrs. Schloesing and Rolland, I must state that these gentlemen in their various publications have fully acknowledged that the process they endeavoured to improve had been invented long ago, and that the various chemical operations constituting the process had been described so exactly in a patent taken out in France by Delaunay as to leave to future inventors very little to do.

On referring to Delaunay's patent, dated 27th of May, 1839, this will be found an exact translation of the English specification of Messrs. Dyar and Hemming, of October, 1838, whence it is clear that Delaunay was simply the agent of Messrs. Dyar and Hemming. Inquiring further into this French specification we come, however, upon a remarkable and important fact which has hitherto been left unnoticed. This patent is followed on the 18th of May, 1840, by an additional patent, a facility enjoyed under the French patent law almost free of expense, which has evidently in this instance led the inventors to protect in France most important improvements found out shortly after taking out their original patent, while the high cost of a second English patent has prevented their doing the same in England.

* Brande: Manual of Chemistry 5th edition, pp. 661.
† Lunge: Manufacture of Sulphuric Acid and Alkali, viii. p. 1.
‡ Fremy: Presidential Address to the French Association for the Advancement of Science, 1878. Bouley: President de l'Academie des Sciences; *Comptes Rendus*, T.C. No. 14. Scheurer Kestner: Conference a la Societé d'Encouragement sur Nicolas Leblanc, 28 Mars, 1885.

As is well known, the original process of Messrs. Dyar and Hemming consisted in mixing a solution of common salt with solid carbonate of ammonia, separating the bicarbonate of soda formed from the residual liquor, boiling this liquor to dryness, and heating the dry product with chalk in order to recover the carbonate of ammonia employed. It is evident that this series of operations would involve so serious a loss of ammonia as to make the economical application of the process impossible, and if Messrs. Dyar and Hemming had left their process in this very incomplete form, their claim to be considered the inventors of the process now known as the Ammonia-soda Process might well be called in question. The additional French patent referred to above, however, puts the matter in an entirely different light. I give an exact translation of their specification:—

18th May, 1840. *Additional Patents for Improvements.* The operations can be reduced to the following:

Preparations of the Carbonate of Soda.

1st. To a concentrated solution of chloride of sodium is added an equivalent quantity of sesquicarbonate of ammonia in order to decompose it.

2nd. A current of carbonic-acid gas is passed through the mixture to saturate the ammonia, and to make the decomposition as perfect as possible.

3rd. After a sufficient time the saline deposit is collected on filters.

4th. The deposit is drained and washed either with water or with a concentrated solution of bicarbonate of soda.

5th. The saline deposit is submitted to pressing, or put immediately in a reverberatory furnace or in a retort to drive off the water, the excess of carbonic acid, and the ammoniacal salts which it may contain.

Extraction of the Ammonia from the Residues of the Operation.

1st. The liquid collected in the third operation contains ammoniacal salts; it is run into a distilling vessel.

2nd. To this liquid is added a sufficient quantity of lime to decompose the entire quantity of the ammoniacal salts, heat is applied and thus ammoniacal gas is obtained.

The ammonia gas can be employed in several different ways.

It can be simply dissolved in water.

It can be passed into a concentrated solution of chloride of sodium.

When the gas has been dissolved in water chloride of sodium is added in sufficient quantity relative to the alkalimetric value of the liquor, and then a current of carbonic acid gas is passed through to effect the decomposition of the chloride of sodium.

If the ammonia gas is added to the solution of chloride of sodium, one can at the same time or successively pass a current of carbonic gas through it.

The order of the preceding operations shows that the sesquicarbonate of ammonia is employed only once, and that after it has been decomposed, the ammonia it contains is continually used over.

In all cases, and whatever be the mode of proceeding, the chloride of sodium is decomposed under the influence of ammonia and carbonic acid.

In this operation the ammonia must be considered as an intermediate agent which takes hold of the carbonic acid to give it off again to the chloride of sodium, which it can then decompose, and produce carbonate of soda through the intervention of the elements of water.

The ammonia plays here a part similar to that of the binoxide of nitrogen in the preparation of sulphuric acid, and to that of the acetate of lead in the manufacture of white lead by the process of Thénard.

In order to make this process economical, the principal object should be the preservation of the ammonia, the employment of which ought to be continued till it is, so to say, used up.

As to the carbonic acid likewise employed in this process, it can be produced economically by the combustion of coal, or by the calcination of limestone as practised in other manufactures.

Here we have described in detail all the operations as they are this day carried out in the manufacture of the immense quantities of ammonia-soda now produced, and we may well agree with Messrs. Schloesing and Rolland that, as far as the chemistry of the ammonia-soda process is concerned, Messrs. Dyar and Hemming left very little to do to future inventors. Still there is the fact that from 1840, when the chemistry of the process was fully developed, until 1865, this remarkably simple and beautiful process found no application, although many very eminent engineers, chemists, and manufacturers spent years of their time and large sums of money in endeavouring to realise it on an industrial scale. All these attempts, including the one made by Messrs. Schloesing and Rolland between 1855 and 1858, ended in failure. If it could be shown that these gentlemen, by the apparatus they have patented, or by the experiments they have made to work the process on a large scale, had advanced the ultimate success of the process, they would, although not being the inventors of the process, deserve great credit, and no objection could be raised to the award of the diploma of honour which they have obtained at the Vienna International Exhibition. A close examination of the facts unfortunately does not show that they have in this direction done more than their predecessors and contemporaries.

The fact that bicarbonate of soda is formed by mixing carbonate of ammonia with a strong solution of salt has been known, although it was never published, long before the date of Messrs. Dyar and Hemming's patent. A. Vogel* tells us that he found this fact mentioned in his father's note-book as far back as 1822. Dr. Angus Smith has told me that his friend Mr. John Thom has shown him this reaction, performing it in the palm of his hand, several years before 1838. I owe to Mr. Watson Smith fuller particulars of Mr. Thom's early work in connection with this subject, contained in several letters from Mr. Thom himself, which are corroborated by a letter from Mr. William Henderson, of Glasgow. These letters leave no doubt that Mr. Thom actually manufactured soda by the action of carbonate of ammonia upon salt in 1836 at the works of Messrs. Turnbull & Ramsay at Camlachie, where he was employed as chemist. Mr. Thom mixed the two salts intimately with a small quantity of water, and put the resulting magma in bags into a press in order to separate the liquid from the bicarbonate formed. The bicarbonate was used for making soda-crystals, of which about two hundred-weights per day were produced. The liquid was evaporated, mixed with chalk, and heated in iron retorts to recover carbonate of ammonia. After working the process for about a year, Mr. Thom left the works at Camlachie, and did not follow up the subject any further. Here we have in all probability the first attempt to turn the reaction between salt and carbonate of ammonia to practical use. But the operations were still so crude, the separation of the bicarbonate of soda from the chloride of ammonium so unsatisfactory, the reaction between salt and sesquicarbonate of ammonia without the aid of carbonic acid so imperfect, and the process used for recovering the carbonate of ammonia so impracticable, that however highly we may think of Mr. Thom's merits as the discoverer of the principal reaction, and as the first who attempted to manufacture soda by its aid,

* *Chem. Centralblatt*, 1874, p. 98.

yet he cannot be considered to have invented a chemical process industrially applicable for this purpose. The merit of having invented the series of reactions now forming the ammonia-soda process remains thus undiminished with Messrs. Dyar and Hemming, who, as far as can be inferred from Mr. Thom's letters, have worked quite independently of him and without knowledge of what he had been doing.

According to information, for which I am indebted to Mr. Richard Muspratt, Messrs. Dyar and Hemming built a small works to demonstrate their process in Whitechapel very shortly after taking out their patent. These works were regularly visited by Dr. Sheridan Muspratt and Mr. James Young of paraffin celebrity, then assistant to Professor Graham in London, in order to study the process. Shortly afterwards, probably in 1840, Mr. James Muspratt engaged Mr. Young to erect plant for the process on a considerable scale, at his large chemical works at Newton. This plant was worked under Mr. Young's direction for about two years, when the process was given up because it was found more expensive than the Le Blanc process, principally on account of the heavy loss of ammonia. Mr. Carrol, at the time foreman of the works at Newton, has told me that about £8000 were spent in this experiment.

It is well known that various other attempts to work the process were made about this time on the Continent, amongst others, by Kunheim in Berlin, and Seybel in Vienna. A few years later a small plant was erected near Leeds by Mr. Bowker, and kept at work for several years, the product being regularly sold in the district, but this also was subsequently abandoned. The first attempt to construct a more perfect plant for carrying out the process was made by Mr. William Gossage (patent of 21st February, 1854). In the same year, and following each other in close succession, patents were taken out by Turck (26th May), Schloesing (21st June), Henry Deacon (through his agent, Henry Johnson, 8th July). I am informed by Mr. Holbrook Gaskell, who entered into partnership with Mr. Deacon in 1854, that Mr. Deacon leased land for the purpose of erecting ammonia-soda works in 1853, and that in the following year he was already engaged in the manufacture of ammonia-soda, which he carried on for about two years at the rate of several tons per day. After a sum of from five to six thousand pounds had been expended upon it, the firm decided to abandon the ammonia-soda process, and commenced the erection of the large Le Blanc Soda Works, which have since become so well known, and which have proved such a fruitful field for the display of Mr. Deacon's great powers as a manufacturer and as an inventor.

Judging from Mr. Deacon's patent, and from what he has told me himself many years ago, the plant which he used for making ammonia-soda was very similar to that described by Messrs. Schloesing and Rolland in their patent of 1858, except that Mr. Deacon went a considerable step further than these gentlemen by using carbonic acid under pressure. He used horizontal cylinders with agitators for absorbing the carbonic acid, and a still of the Coffey type for recovering the ammonia.

Messrs. Schloesing and Rolland commenced in 1855 to erect works at Puteaux, near Paris, which were kept going for two years, and during this time produced 316 tons of soda—86 tons during the first 14 months, and 230 tons during the last ten. At the end of the two years the experiment was given up, like all the preceding ones had been, although the soda manufactured was sold at a price varying from 65 to 75 francs per 100 kilogrammes, equal to £26 to £30 per ton, or about five times its present value. Messrs. Schloesing and Rolland assert, in a very lengthy paper published in 1868 (*Ann. de Chimie und Physique*, T. xiv.), and this assertion has been repeated by various writers, that their want of success has been due, not to the insufficiency of their apparatus, but solely to the high tax levied on salt at the time in France. They state that they had to use 180 kilogrammes of salt per 100 kilogrammes of soda, where the Le Blanc makers used 150 kilogrammes, and that the tax they had to pay on this extra quantity of salt made competition impossible. This duty amounted to 10 francs per 100 kilogrammes of salt. Messrs. Schloesing and Rolland would thus have to pay 3 francs per 100 kilogrammes of soda more than their competitors, an amount very much below the difference in cost of production between the two processes at the present time. The total tax they had to pay on salt would have amounted to 18 francs per 100 kilogrammes of soda manufactured. The selling price of soda at the time being 65 to 70 francs per 100 kilogrammes, Messrs. Schloesing and Rolland ought to have realised enormous profits in spite of the tax if they had at all understood the manufacture. The selling price to-day is below 18 francs per 100 kilogrammes, and this leaves a very handsome profit. Moreover, it would have been easy to reduce the quantity of salt consumed per ton of soda in the ammonia-soda process to a less quantity than is used in the Le Blanc process, by recovering the undecomposed salt from the residual liquor of the distillation. We can, therefore, not accept the assertion that but for the salt duties Messrs. Schloesing and Rolland could have manufactured at a profit; their own figures prove plainly that their experiment was no more successful than their predecessors; that it was not carried out on any larger scale, nor persevered with for a longer period of time.

After 1858 no further serious attempts were made to overcome the engineering difficulties of the ammonia-soda process, until Mr. Ernest Solvay undertook this task in 1863. It is now a matter of history how completely Mr. Solvay succeeded, after five years of incessant work, under trying circumstances, in inventing and working out new apparatus for carrying out on a large scale all the various operations of Messrs. Dyar and Hemming's beautiful but hitherto barren invention; how quickly the ammonia-soda manufacture has developed in his hands, and what enormous proportions it has attained in a comparatively short time. While recognising Messrs. Dyar and Hemming as the inventors of the chemical operations which constitute the ammonia-soda process, we have to give to Mr. Solvay the honour of being the inventor of the apparatus, which alone has made this process of value to the public, and of having thus become the founder of the ammonia-soda industry.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

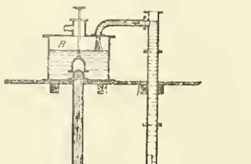
Improved Process and Apparatus for Purifying Water used in Steam Boilers. D. Clerk, Glasgow. Eng. Pat. 10,815, July 31, 1884.

THE water of the boiler is made to circulate, by means of pipes and a steam pump, through a filter, and is redelivered at the upper part free from the solid matters which separate from it during evaporation. The feed water is also caused to pass through the same filter.

—C. C. H.

Improvements in and Apparatus for the Production of a Vacuum in the Evaporation or Refrigeration of Liquids. G. Hambruch, Berlin. Eng. Pat. 11,485, August 21, 1884.

To produce a vacuum more quickly and efficiently than by means of ordinary pumps, under such circumstances as the evaporation of liquids under reduced pressure, it is proposed to use an aspirator, or liquid jet pump resembling a "Körting's aspirator," worked by a liquid such as sulphuric acid, caustic soda, etc., which readily absorbs aqueous vapour. The best results are obtained



by aspirators delivering the liquid in flat sheets or annular jets. In the annexed illustration A is the aspirator, *a* is the pipe from the vessel to be exhausted, B the reservoir for supplying the liquid under pressure, and P the pump for returning the liquid to B. The absorbing liquid becomes diluted and must be changed at intervals.
—C. C. H.

Improved Apparatus for obtaining Fresh Water from Salt Water. J. Weir, Glasgow. Eng Pat. 11,865, September 2, 1884.

THE apparatus consists of three vessels placed in series, and intended to be worked in conjunction with the engines and boilers of a steam-ship. The vessels are upright cylinders, provided with a tight cover, and a worm in the interior. The first vessel communicates with the worm of the second, and the worm of the third is a continuation of that of the second. The first of the series is filled with sea-water, steam is admitted to the worm from the boiler, or the exhaust of the main engines, and the vapour thus generated is condensed in the worm of the second vessel, and, passing over into the worm in the third, is cooled by a current of cold sea-water. The condensed water from the steam admitted into the coil in the first is returned to the hot well of the engines. The second vessel communicates with the condenser of the main engines, so that the vapour given off is condensed and returned to the boilers to make up for the loss due to waste in the whole system.
—C. C. H.

Improvements in the Manufacture of Asbestos Micromembranes for Filtering Purposes. O. Imray, London. From F. Breyer, Vienna. Eng. Pat. 5864, May 12, 1885.

THIS invention relates to the manufacture of thin layers of asbestos felt suitable for filtering purposes. Only those asbestos fibres are suitable which, when ground, give a woolly product, and not a powdery one. After reduction to this state, by a mill or edge-runner, the product is chopped so fine that the fibres do not exceed 0·2 inch in length. It is then mixed with crystalline carbonate of lime, or magnesia, the granules of which do not exceed 0·2 inch in size, and ground with water so as to effect a further reduction. The semi-fluid resulting is then treated with an acid to remove the carbonates. After washing, to remove the excess of acid, the emulsion is ready to be filtered. This is best carried on by depositing successively even layers upon a woven fabric stretched on a frame. When a felt of sufficient thickness has been obtained, the fabric to which it adheres is dried in a kiln, and the whole is then ready for use.—C. C. H.

Improvement in Filter Presses. O. Imray, London. From H. B. Scott, Calais. Eng. Pat. 5903, May 13, 1885.

THE improvement described consists in forming the plates of a filter-press of flat sheets of wrought-iron, the plates being covered with cocoa-nut matting, to form a soft bedding and a drainage surface. The filtering cloth is fixed on the plates in the usual manner. The chambers are formed by the interposition of distance frames between the flat plates.—C. C. H.

Improvements in Concentrating Aqueous Solutions, etc., and Apparatus therefor. W. P. Thompson, Liverpool. From A. Büttner and C. Meyer, Merdigen. Eng. Pat. 6065, May 18, 1885.

THE concentration of liquids is to be effected by direct contact with the products of combustion, generator gases, etc., without subjecting the concentrated material to burning. The gases are first deprived of ashes and soot by passage through a V-shaped chamber, the solid matter being thrown down into a pocket by a curtain wall. The hearth of the evaporating furnace is divided by cross walls into compartments, into which the concentrated materials successively flow. In each of the compartments there is one or more gratings suspended, with the bars vertical and provided with cams and rods for alternately lifting them out of and lowering them into the liquid. The bars are toothed or serrated so that they pick up more liquid. The current of hot air is passed over the liquid, and hence through the gratings and the liquid raised by them, and the heat is uniformly conveyed through the body of the liquid. The solid matter from the end of the hearth is conveyed by a creeper into U-shaped vessels, through which currents of hot air are passed, rakes and scrapers at the same time keeping the semi-solid matter from balling. The passage of the matter is so arranged that dry matter is discharged from the end trough of the series.—C. C. H.

Apparatus for making Fresh Water from Salt Water. A Chapman, Liverpool. Eng. Pat. 11,461, August 20, 1884.

REFER to Branch XVII. (*B*) of the present number of this Journal.

II.—FUEL, GAS, AND LIGHT.

Improvements in the Manufacture of Illuminating Gas from Hydrocarbon and other Oils, and in Apparatus therefor. A. J. Boult, London. From J. Hanlon, New York. Eng. Pat. 802, January 20, 1885.

THE operation of the apparatus, for the construction of which the patent must be consulted, is as follows:—Heating gas is generated in a producer, partially

burned in a retort chamber, and passed on to one of the fixing chambers, where a further air supply completes its combustion. When all is heated to the proper temperature, the gate valves are reversed, turning the heating gas into the other fixing chamber and opening the connection between the retorts and the now heated fixing chamber. Oil is admitted to the one and superheated steam to the other compartment of each retort. The steam passing downwards through the heated charcoal is decomposed, and, passing through the aperture in the partition, assists in the vaporisation of the oil, the hydrogen acting as a carrier for the rich, heavy hydrocarbon vapours, which would otherwise probably condense in the connections. The mixed gases pass onward to the fixing chamber, whence they emerge as a homogeneous illuminating gas of high candle-power.—A. R. D.

Improvements in the Construction of Coke-Ovens. A. F. Link, London. From T. Bauer, Munich. Eng. Pat. 11,040, May 7, 1885.

THIS specification describes a coke-oven system claiming economy of space, building material, and working expenses, with a superior quality of coke. See this Journal, vol. iv. 485 and 486.—A. R. D.

An Improvement in Coke-Ovens. Henry Simon, of Weissbad, Apenzell, Switzerland. Eng. Pat. 12,340, June 2, 1885.

THIS invention is a modification of that described in Specification 554, of 1883 (this Journal, vol. iii. 507). Therein it is shown how the products of combustion on their way to the chimney are employed to heat the air or combustible gas required for the working of the ovens. This is done by causing the latter to traverse flues adjacent to those in which the former are passing away, forming what is known as a recuperator. In this way the air was frequently rendered hotter than was necessary, and, therefore, according to the present invention, cross-flues or channels, having openings provided with valves and dampers, are constructed at various points in the length of the longitudinal recuperator flues, so that the cold air can be admitted at these different points and be made to take up more or less heat according to the length they have to traverse on their way to the combustion chamber. —A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Coal-Tar Creosote. Dr. Tidy. Analyst, **10**, 115.

THE author suggests the following as an amendment to the late Dr. Voelcker's specification for coal-tar creosote. 1. The creosote to be completely liquid at a temperature of 100° F., no deposit afterwards taking place until the oil registers a temperature of 95° F. 2. Creosote to contain at least twenty-five per cent. of constituents which do not distil over at a temperature of 600° F. 3. That, tested by the process afterwards described, the creosote shall yield a total of eight per cent. of tar-acids. 4. There shall be no admixture of bone-oil, shale-oil, or other substance not obtained by the distillation of coal-tar, and the first twenty-five per cent. of the distillate shall have a specific gravity greater than that of water. *Process for determining the coal-tar acids*:—1. 100cc. of the well-mixed creosote to be distilled at 600° F. until no further distillate comes over. Distillate to be mixed and well shaken in a stoppered flask, with 30cc. of caustic-soda solution (sp. gr. 1·200). Mixture then to be heated, and afterwards again shaken vigorously. The contents of the flask are now to be placed in a separating funnel, and the soda solution is drawn off. The creosote is to be heated a second and a third time in a similar manner with caustic-soda solution, only 20cc. of soda solution being used, instead of 30cc., as in the first extraction. 2. The three soda solutions are now to be mixed together. When cold, any particles of creosote are to be got rid of by means of a separating funnel. The solution is now to be thoroughly boiled, in order to expel the last traces of creosote present in the solution. The mixture is then to be allowed to cool. When cold, about 35cc. of sulphuric acid (one of acid to three of water) is added, until the solution becomes slightly acid to litmus. The whole is then transferred to a separating funnel, and allowed to stand until quite cold. The tar-acids are now to be dissolved in 20cc. of the caustic-soda solution and 10cc. of water, and the mixture is boiled and filtered through asbestos. The latter is to be washed with not more than 5cc. of boiling water. The solution is allowed to cool *perfectly* in a 100cc. measure; it is then slightly acidified with sulphuric acid (one to three), and again allowed to stand for two hours, until perfectly cold, when the percentage of the tar-acids (by volume) is to be read off. *Process to be adopted in estimating the quantity of distillate*:—The operation is to be conducted in a retort fitted with a thermometer, and heated with the naked flame of a Bunsen burner. The heat is gradually to be raised to 600° F., and continued at that temperature until no further matters distil over. The distillation of the 100cc. should be completed within an hour.—E. G. C.

An Improved Method of and Apparatus for Extracting Tar and Ammonia from the Gases of Blast Furnaces. J. Dempster, Newton Heath. Eng. Pat. 11,250, August 14, 1884.

THE apparatus employed is placed in a position between the blast furnaces and the steam boilers or stoves to which the gases from the furnaces are conveyed. It consists of an ordinary ammonia still, with its usual "sulphate" apparatus, and of "dust boxes" and "condensers." The gases are afterwards taken to "washers" and "scrubbers," where the last traces of ammonia are absorbed, and after leaving the scrubbers they are conveyed to the boiler furnaces.—D. B.

Improvements in the Treatment of Oils and Tars obtained from Blast Furnaces and Gas Producers for the Production of Valuable Hydrocarbons therefrom. C. E. Bell, Durham. Eng. Pat. 12,681, September 22, 1884.

IN a former specification (Eng. Pat. 9510, 1884), the treatment of oils and tars obtained from coke-ovens was described, the object being the production of hydrocarbons of the benzene, naphthalene, and anthracene series. The inventor has since discovered that a similar treatment is applicable to oils and tars obtained from blast furnaces and gas producers by passing such oils into a retort heated to or beyond a full red-heat, and by preference charged with coke.—D. B.

IV.—COLOURING MATTERS AND DYES.

A New or Improved Process for the Manufacture of Napthol Carbonic Alkaline Salts, and also their Subsequent Treatment for the Production of α- or β-Carbonaphthol Acid Alkaline Salts. From Dr. Carl Kolbe and Carl Reutsch, of Radebeul, Saxony. Eng. Pat. 6134, May 19, 1885.

THE authors act upon dry alkaline salts of α- or β-naphthol by dry carbonic anhydride to produce the alkaline salts of the acid carbonic α- or β-naphtholethers—

$$\left(\overset{\alpha \text{ or } \beta}{C_{10}H_6(OH)(COOH)}\right).$$

The alkaline salts of the α- and β-naphthol are treated with carbonic anhydride, at ordinary temperatures, and after lapse of time and frequent stirring, the conversion of the naphthol salt into naphthol carbonic salt (oxynaphthoic acid salt) is completed; then the vessel is heated to 120—140° C., in order to effect conversion into simple α- or β-oxynaphthoic acid salt. Dry alkali naphthol salts are placed in an autoclave and sufficient solid carbonic acid is thrown in to bring about the formation of the naphthol carbonic alkaline salt.—T.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On Rhea Ramie Fibre, or China Grass. From a Lecture delivered in the Manchester Technical School, July 2t, 1885. By Dr. Forbes Watson.

THERE are two principal varieties, the one *Boehmeria nivea*, or *Urtica nivea*, with a white underleaf, and the other, *Urtica utilis*, with a green underleaf.

In China, when the stalks are cut, the bark is stripped off at once by hand, and this can be very easily done when the stems are quite fresh, and in this case the bark contains the whole of the fibre. The China grass of commerce is obtained by scraping this bark by hand by means of a knife, but only a small quantity can be produced per day by these means. In China a very clever worker can produce up to two pounds of fibre per day, while on the average only a half to one pound is generally obtained. In experiments made in India with unskilled labour, the production was very small indeed, in fact, not more than four ounces per day could be produced by each worker. As will be easily understood, this slow method of preparation has prevented the development of the industry.

China grass, as usually imported, varies from three to four feet in length, and therefore it can be inferred that the plant is allowed to reach a height of 3½ to 5 feet.

China grass contains from twenty-two to twenty-eight per cent., and in some cases up to thirty-five per cent. of gum; this has to be removed in order to obtain the pure fibre capable of being spun.

In Beheea, in Bengal, the bark is simply stripped off from the stalks, and dried, and is then brought into commerce in this raw state.

When the stems have been cut for any length of time the stripping by hand could not be performed without leaving a certain amount of the fibre adhering to the stalks, while if the stems are fresh the amount of fibre left behind is very insignificant.

The Favier's process consists in exposing the stems in the green state to the action of steam for fifteen to thirty minutes in a wooden box, after which the bark can be very readily stripped off by hand; by this process also those stems can be treated which have been standing for some time after being cut, without leaving any appreciable amount of the fibre adhering to the stalks.

Some years ago Dr. Watson made numerous experiments on a large scale with the dry stems sent him by the India Office, and he proved that it is not at all difficult to obtain the fibre when the stems are quite dry.

In his report to the Government he called attention to the importance of this treatment of the dry stems, but the reply was to the effect, that it is all very true if the stems can be dried, but the best crops are obtained in India during the rainy season, when it is all but impossible to dry them, except by expensive artificial means. They are, if not quite dry, very liable to ferment, and this results in the spoiling of the fibre.

The Government of India has for many years been endeavouring to find out a machine capable of treating the stems in the green state, and very many trials have been made. In the competition of October last in Calcutta, the Death and Elwood machine was found successful for the separation of the raw fibre from the wood. The fibre produced Dr. Watson had found to contain fifteen to twenty per cent. of gum, but in some instances the figure is as low as five per cent.

The machine is also useful for the separation of the fibre from the pine-apple leaves and the agaves and other plants. It consists of a cylinder with beaters revolving at a high speed in front of a table where the stocks are introduced, being pushed against the beaters, which separate very quickly the wood from the fibre; a jet of water is supplied which helps considerably in the cleansing of the fibre, either by washing off the gum and other soluble matters or by keeping the fibre up to the action of the beaters, and in this case the water acts also as a kind of cushion. The stems are treated so, that after half of their lengths has passed through, they are taken out and the other half is exposed in its turn to the action of the beaters.

The cost of producing the fibre by this machine is estimated by Dr. Forbes Watson to average £4 to £5 per ton, but in no case did it exceed £7. The yield from the machine was from one to two tons of green stalks per day, and he expected that, properly worked, this would produce about 100lbs. of cleaned fibre.

In order to utilise the China grass for industrial purposes it was necessary to deprive it of its gum, and make it into pure fibre ready for spinning. Different chemical methods have been recommended for the purpose of ungumming. As to the question, "Which is the best process?" Dr. Watson saw the Frémy-Urbain process at Paris some time ago, but thought it was very imperfect. Since, then, however, it has undergone several improvements, as the abstractor (Mr. A. Sansone) can also testify, having lately seen it in Paris. The process is principally applied for the treatment of the dry barks or ribbons obtained by the Favier's steaming method.

Dr. Watson thought that in some cases the fibre might be injured by this process, or, at all events, that the amount of short fibre or noils obtained when spinning the material so prepared would be much larger than it ought to have been, and that consequently the amount of longer fibre, which fetched a much higher price, would be considerably reduced. He evidently objected to the use of pressure boilers or kiers for the treatment of the material with caustic soda, and stated that the operations of ungumming could be carried on without such apparatus; he had also seen samples successfully ungummed by other workers, and he knew of at least twenty processes which had been recommended. The question was not if the operations could be carried out on small samples, but if they can be conducted on a manufacturing scale. What is now principally wanted is raw material to work upon. Dr. Watson did not believe that in all Europe there is as much as forty tons of the fibre at the present moment. He thought that the cultivation of the plant ought to be extended and encouraged. The beautiful patterns of yarns and fabrics exhibited showed what was being done on the Continent. In reply to a question as to what kind of flowers and seeds the plant bore, Dr. Watson said that none of the plants they had in India had produced fertile seeds. The amount of pure fibre obtained from the green stalks was from two to three per cent., in some cases up to 3¾ per cent.

Mr. Sansone, who said he had lately been in Paris and Louviers to see the Frémy-Urbain process at work, stated that the treatment of the plants in the green state was suitable principally for large plantations, but for small cultivators like those found sometimes in his own country (Italy) it would be less suitable; they would have to deal with the dry stems, or strip the bark by hand, for as the peasants only cultivate small plots of ground they could not afford to put up either boilers or machinery for the treatment of the green stems.

As regards the employment of pressure kiers, the ungumming *could* be performed without them, but it had been found that a certain amount of pressure facilitates the operations considerably, as it allows the liquor to penetrate through the mass; this is of importance when working on large quantities. On the amount of very long fibre yielded by any process, no great stress need be laid, since the long fibre is generally cut in lengths of eight to ten inches before spinning. In the opinion of practical men engaged for years in the manufacture of China-grass goods, it would be even an advantage to have only to deal with a short fibre.

From what Mr. Sansone had seen in the ungumming processes as carried on at Paris, or rather at Louviers, he considers that there is neither in the chemicals nor in the treatment anything to injure the fibre, if the operations are performed with care. The process resembles in a certain sense the scouring and bleaching processes as generally carried on with cotton-goods in Lancashire.

Method of rendering Cloth, Wood, or Paper Waterproof, but not Air-tight. N. A. Alexanderson, Stockholm. Eng. Pat. 15,923, December 3, 1884.

THIS invention is based upon the well-known property of fibres of decomposing certain salts—*e.g.*, those of

alumina,—alumina or a basic salt being taken up by the fibres and preventing water from moistening them. In this way it is possible to give a cloth a certain amount of impermeability by the double decomposition of lead acetate and aluminium sulphate. An improvement on this method consists in giving the tissue so treated a subsequent rinsing in a soap solution, whereby an aluminium soap is produced. A very essential improvement consists in depriving the salts used of their acid property, which is injurious to impregnation, and so to increase the capacity of fibres for alumina. Inventor has attained this result by using basic salts instead of the acid compound formerly employed. These basic salts are obtained by neutralising alum, sulphate or acetate of alumina, or any suitable salt of aluminium by equivalent quantities of any neutralising matter—*e.g.*, the carbonates or hydrates of the alkalis and of alkaline earths or hydrates of heavy metals. Thus the following equation may be considered a type :—

$$Al_2O_6.3(SO_3) + CaO_2H_2 = CaO_2.SO_2 + Al_2\left\{\begin{matrix} O_4.2(SO_2) \\ O_2.\ \ H_2 \end{matrix}\right.$$

Basic Salt.

Inventor may use tartaric or citric acid or glycerol to prevent premature deposition. Basic salts deposited *in statu nascendi* are easily taken up by the fibre. Aluminate of soda and basic chromium and iron salts may also be used.—H. A. R.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in Machinery for Dyeing Textile or Fibrous Materials. W. R. Lake, Middlesex. From C. Corron, France. Eng. Pat. 11,824, August 30, 1884.

THIS invention relates to apparatus for mechanically dyeing spun materials, which are wound into skeins, and preventing the skeins from becoming entangled with each other. The apparatus may be used for boiling, washing, mordanting, brightening, and staining silks, cotton, wool, linen, China grass, or any textile or fibrous material, by the submersion of a frame charged with skeins, and by the rotation of rollers. For drawings and details the original specification should be consulted.

—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

A New Variety of Pyrites for Sulphuric Acid Manufacture. Drinkwater. Analyst, 10, 109.

THE author, after referring to the fact that pyrites nearly always contain arsenic, gives analyses of two samples recently examined by him, and found to be free therefrom. One was a Welsh pyrites, the other Algerian. The former contained :—

Insoluble matter	5·8
Sulphur	48·3
Iron	42·1
Arsenic	nil.
Alumina	1·4
Carbonate of calcium	2·5
	100·1

The Algerian pyrites contained :—

Sulphur	44·8
Insoluble	5·2
Iron	46·6
Lead	0·02
MnO_2	0·22
Calcium carbonate	3·1

The acid manufactured from the Welsh pyrites contained :—

Hydrated sulphuric acid	97·14
Water	2·826
Sulphate of lead	0·003
Saline matter	0·031
Arsenic	nil.
Nitrogen compounds	nil.
	99·80

This acid is as good, for any commercial purpose, as the best sulphur acid, and is much cheaper. The Welsh ore is raised from the Cae Coch Mine. The sulphur known as recovered sulphur is not always free from arsenic. The following figures represent the amounts of arsenic discovered by Dr. Drinkwater in various specimens of pyrites, and in one of recovered sulphur :—

	1.	2.	3.
Cornish pyrites	0·93	0·56	0·5
Norwegian ,,	0·32	0·20	—
Belgian ,,	0·40	1·03	0·22
Spanish ,,	1·81	1·65	0·89
Irish ,,	2·00	—	—
Recovered sulphur	0·68	—	—

—E. G. C.

Improvements in obtaining Hydrochloric Acid Gas from a Solution of Hydrochloric Acid. W. Lloyd Wise, London. From Messrs. Solvay & Co., Brussels. Eng. Pat. 12,421, March 18, 1885.

THE solution of hydrochloric acid is introduced into a nearly boiling solution of calcium chloride so concentrated that the boiling point of the mixed liquids does not fall below 100° C. A solution of calcium chloride boiling at 150° C. to 160° C. answers very well. Agitation is produced by suitable means, and the hydrochloric acid is evolved in the gaseous form, while the water in which it was dissolved is retained by the calcium chloride. The operation may be made continuous by passing through an apparatus divided into several compartments a current of hot calcium chloride solution, and at the same time such a quantity of liquid hydrochloric acid as it is capable of decomposing. To the calcium chloride solution remaining at the end of the operation a little lime or carbonate of lime is added to neutralise the traces of acid retained. It is then concentrated and used over again.—A. R. D.

An Improved Method of Making Sodium Carbonate and certain By-products. W. Robinson, Gateshead. Eng. Pat. 10,080, April 10, 1885.

THE inventor intimately mixes together common salt, pulverised coal, or other carbonaceous material, and sulphuric acid. The mixture is heated in a furnace, and the evolved gases treated for the recovery of hydrochloric acid, sulphurous acid, and sulphuretted hydrogen. The contents of the furnace are treated by certain well-known methods for the production of sodium carbonate, sodium bicarbonate, soda ash, sulphur, sulphuretted hydrogen, etc.—A. R. D.

Improvements in Furnaces for Chemical Processes. J. Mactear, Glasgow. Eng. Pat. 10,812, July 31, 1884.

THIS specification describes improvements upon patents 4870 of 1879, and 4511 of 1880, granted to the author, and their object is to so apply the heat that the fire gases may not come in contact with the materials to be furnaced or be mixed with the gases evolved therefrom. The improvements will be better understood by reference to the annexed drawings. The revolving bed of the furnace (3), made of fire brick and bound with the iron or steel frame (4), is rotated on the rollers (5) by the pinion (34) and the rack (33). Above the bed is the domed crown of the furnace (8), and immediately over this the flue (9). Under the bed another flue (10) is formed ; the gases from the furnace (13) circulate above and below the rotating bed. Entering the flue (9) from the passage (12) communicating with the source of heat, the hot gases pass between walls (11), Fig. 1, across the centre of the crown, and diverging right and left escape down the vertical flues (14), and emerge into space (10) by flues (15) and (16). From thence they pass by openings (18) into exit flue (17). The material furnaced overflows the edges of the hearth into the ring (20), and with the curb (23) forms a lute between the interior of the furnace

FIG. 1

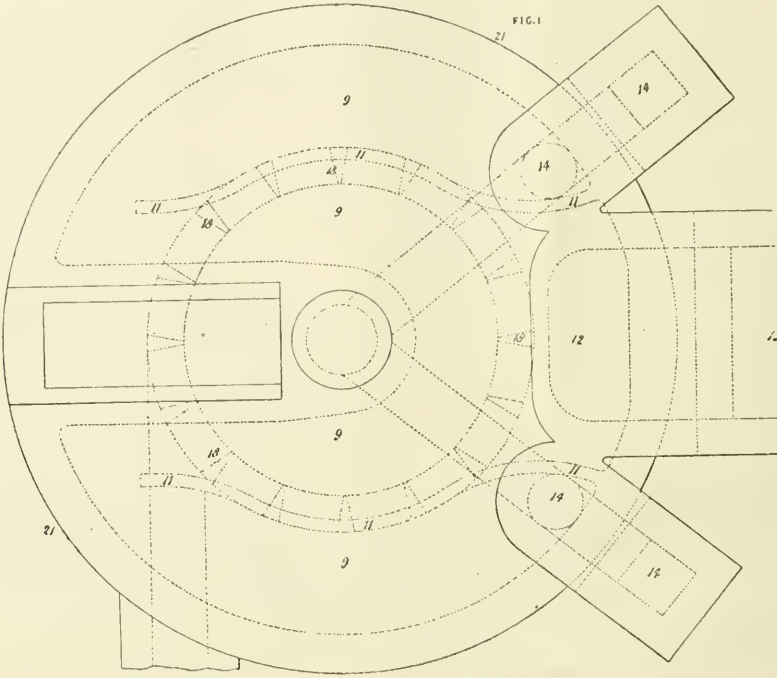

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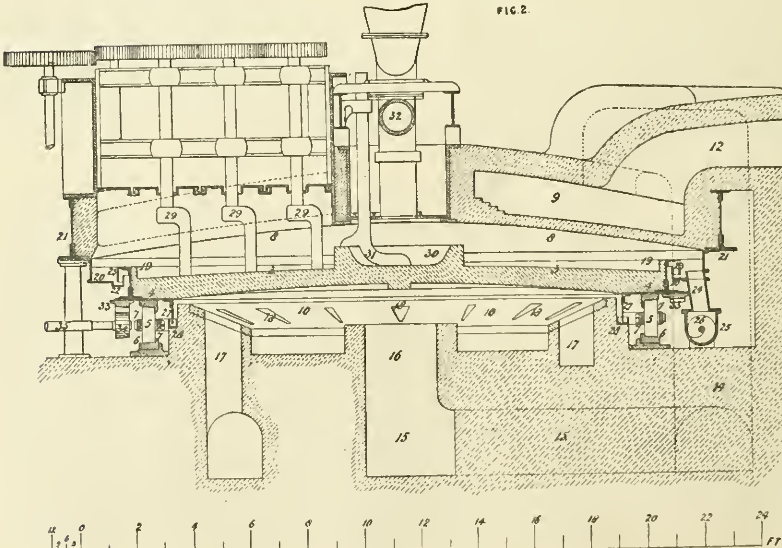
FIG. 2.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and the air. A similar device (27) and (28), the trough being filled with sand, lutes the flue (10) against the air. The furnaced product is removed continuously by hopper (24) and creeper (25). Stirring gear (29), as at present used, is provided, and when applied to salt cake the fixed plough (31) and centre pan (30), to effect a partial preliminary decomposition, are also used. The patentee claims the improvements as described. (See this Journal, vol. i. 27—29.)—C. C. H.

A New or Improved Process for the Production of Phosphate of Soda, or of Potash from Basic Process Slags, and other Phosphatic Materials. W. P. Thompson, Liverpool. From Luigi Imperatori, Düsseldorf, Germany. Eng. Pat. 5216, April 27, 1885.

100 PARTS of slag (containing say 50 per cent. lime, 5 per cent. of magnesia, 19 per cent. iron, 20 per cent. phosphoric acid, and 6 per cent. silicic acid) are mixed with 176 parts of sulphate of soda and 74 parts of coal. The mixture is worked in a black-ash furnace, and the semi-fluid mass so obtained is moulded into blocks. These blocks must first be treated in any suitable way with carbonic acid gas to convert the caustic lime which they contain into carbonate. After this they are lixiviated, by which a solution of mixed carbonate and phosphate of soda is obtained. These salts are separated by crystallisation. If the blocks above mentioned were lixiviated directly with water the caustic lime present would cause the almost entire reversion of the phosphate. In preparing the mixture for the furnace it is well to use an excess of slag.—A. R. D.

Improvements in Apparatus for Carbonating Liquids or Semi-fluids. F. G. Riley, Vauxhall, London. Eng. Pat. 11,880, June 2, 1885.

THE apparatus, with its improvements, is designed for the conducting of carbonic acid through liquids, so that convenience in manipulation, economy of time and safety are secured. The blue-book, with its drawings, must be consulted.—A. R. D.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Production of Toughened Glass, and in Apparatus therefor. C. D. Abel, London. From La Compagnie General du Verre et du Cristal Trempès, Paris. Eng. Pat. 10,748, July 29, 1884.

HITHERTO it has been usual in the operation of toughening articles of glass to heat them, after formation, in the same furnace in which the glass was originally heated by simply introducing them into the mouth of the furnace. The result of this is unequal heating, due in some measure to the configuration of the article. The present invention proposes to obviate this by the employment of a special reheating furnace either of the muffle form with two compartments, or else of the ordinary form, but with openings in the sides so that the thinner parts can be kept cool by exposure to the air, whilst the thicker parts are reheated prior to quenching in the bath. To ensure uniformity in the temperature of the oil-bath, the vessel is constructed either with double sides, filled with a non-conductor, or else a movable vat is used which can be placed in a screen or casing.—C. C. H.

An Improved Manufacture of Toughened Opal Glass Articles and Apparatus therefor. C. D. Abel, London. From La Compagnie General du Verre et du Cristal Trempès, Paris. Eng. Pat. 10,768, July 30, 1884.

THE "toughening" process cannot be applied with advantage to articles made from opal glass. To render such objects amenable to this process the present invention proceeds thus :—Articles or sheets of opal glass are coated with ordinary crystal glass and can then readily be "toughened." Any device or pattern can be interposed between the two surfaces of glass, and thus be rendered permanent. A special furnace and appliances are necessary in operating upon articles made from sheets of opal glass as above described. The furnace in which the sheets are heated is constructed after the muffle pattern in order to secure uniformity of temperature. The articles after being moulded must be successively heated upon two moulds which are the reverse of each other, so as to bring the surfaces to the same temper. The invention is covered by two claims—(1.) The manufacture of articles of opal glass toughened as described. (2.) The apparatus used therein.—C. C. H.

Improvements in Gas Kilns for Burning Glass, China, Pottery Ware, and other such like Articles. G. W. Wilkinson, London. Eng. Pat. 1633, February 5, 1885.

THE improved kiln is constructed in wrought iron, of a Ω-shape, and the interior is heated by "atmospheric" gas burners. The exterior of the kiln is covered with fire-bricks, and the ends fitted with doors. The articles to be fired are placed on shelves in a closed chamber similar in shape to the furnace, into which it is run on wheels. When firing has proceeded to a sufficient extent the interior chamber may be removed and run into another chamber, where it is allowed to cool gradually. Three claims cover the invention.—C. C. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Colouring Stone, Marble, and other Materials for Building and other Purposes. Baron de Liebhaber. Eng. Pat. 15,628, May 23, 1884.

THIS inventor uses a solution of nitrate or chloride of copper, followed by caustic soda and sulphides, for the purpose of dyeing stone blue, black, or bronze. Yellow prussiate of potash produces a pink or light red colour on marbles and calcareous stones in their natural state; but on those previously treated with salts of copper, a purple or dark red colour is produced. A blue colour is imparted to stones of any nature, impregnated with yellow prussiate of potash, by means of fluoric acid. On ferruginous stones, such as Bath stones, yellow Yorkshire sandstone, etc., a red colour is produced by coating the surface with a very fine layer of chlorate of potassium, and then directing upon it the flame of a blast lamp until the whole surface is reddened to a slight depth.—E. G. C.

Improvements in the Manufacture of Artificial Stone and the Treatment of its Surface. Herbert John Allison. Eng Pat. 16,000, December 5, 1884.

THE artificial stone, slate, or marble, consists of various mixtures of sand and crushed stone with Portland cement, as follows :—Composition No. 1. By measure, four parts of ground slate, four parts Portland cement, one part (or less) of hydrate of lime mixed by sieving and made into a paste with water. Composition No. 2 has hydraulic lime (lime of Fiel) wholly or partially substituted for the hydrate of lime. Composition No. 3 same as No. 1, without lime. Composition No. 4. Four parts ground slate, four parts powdered limestone or marble, or sand, or a mixture of both ; and one part of slaked or ground quicklime made into a paste with water. Nos. 5 and 6 are slight variations of above. These compositions are compressed or tamped into moulds and hardened by carbonating in a closed chamber, with water containing carbonic acid, or by the gradual action of the carbonic acid and moisture of the air.—H. R. P.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

On the Examination of Fats. R. Bensemann. Rep. Anal. Chem. 11, 165.

AS a test of the genuineness and purity of fats, the author determines the melting point of the fatty acids insoluble in water in the following manner. A drop of the previously fused mixture of fatty acids is placed in the wide portion of a drawn-out tube, as shown at *a* in

the figure, and is then allowed to completely solidify. The tube is now placed perpendicularly or nearly so in a beaker of cold water, containing a thermometer, and heated as gradually as possible over a very small flame, until some of the fat begins to flow down the side of the tube. The temperature observed at this moment is called by the author the "initial point of fusion." The application of heat to the water in the beaker is continued until the fat-drop has taken the appearance and position shown at *b*; and when the last trace of turbidity has disappeared the temperature is again read. This is the "concluding point of fusion." The author finds that this method gives very satisfactory

and concordant results; the two points are very clearly marked and are about 3—4° C. from one another. With pure fats the concluding point is less clearly marked than with fatty acids; in the examination of the former, therefore, the initial point only need be noticed. The author takes 5grms. of the fat for saponification (with 2grms. of caustic alkali and 25grms. of alcohol). The fatty acids obtained by decomposing the soap with hydrochloric acid are thoroughly washed, first with cold and then with hot water. They are then dried at a temperature of 90—100° C. The drying must be continued until the acids cease to lose weight.

The following table contains some results obtained by the author:—

XII.—PAINTS, VARNISHES, AND RESINS.

Treatment of Kieselguhr and Furnace Slag for the Production of a Material applicable for rendering Paints, Varnishes, and other Substances Fire-, Damp- and Weather-proof. Sir S. J. Blane, Bart. Eng. Pat. 9803, July 5, 1884.

POWDERED furnace-slag is treated with hydrochloric acid and steamed, and the jelly-like mass is strained through canvas and freed from acid by washing with water. The slag jelly is then well mixed with ignited and finely-powdered kieselguhr, and to this a little "lime water and gum, or glue solution, or both," are added.—E. G. C.

An Improved Black Pigment. J. Connor, Scotland. Eng. Pat. 11,930, September 3, 1884.

THE material employed is a bituminous or carbonaceous mineral, resembling coal and bituminous shale, and known as "bonnet." This mineral is ground to a fine powder, mixed with about five per cent. of lime, and heated in a retort. After being thus heated, the mixture is reground, and subjected to elutriation and other finishing processes.—E. G. C.

Improvements in the Manufacture of Sulphide of Zinc, and the obtainment of Sulphuretted Hydrogen and Sulphurous Acid as Products of the said Manufacture. J. H. Johnson, London. From T. Macfarlane, Montreal. Eng. Pat. 13,045, April 7, 1885.

ZINC, impure zinc oxide, or ores containing oxide or carbonate of zinc, are dissolved in hydrochloric acid till the latter is neutralised, and the solution is evaporated to a sp. gr. of at least 1·6 in lead or cast-iron pans. The chloride of zinc solution is added to a "sulphur liquor," prepared as below:—(1.) Two parts of quicklime are slaked and mixed with one part of ground sulphur, and boiled with water for two hours. (2.) One part of quicklime is slaked, mixed with one part of "spent oxide," and boiled with water for two hours. The solutions each contain hydrosulphate and hyposulphite (thiosulphate) of calcium, together with some pentasulphide. (3.) Ordinary tank waste from the alkali manufacture is exposed to the atmosphere for three or four weeks on an inclined water-tight floor. This is leached with water, and the solution so obtained is concentrated to from 10° Tw. to 20° Tw., by treating fresh quantities of weathered tank waste. It then contains from 2¼ to 2½ equivalents of sulphur to one equivalent of calcium. When this liquor No. 3 is used for the production of sulphide of zinc as above, there is an abundant evolution of sulphuretted hydrogen, which may be burned in a suitable furnace, and also utilised for vitriol making. The precipitated sulphide of zinc, after ignition, is used as a white pigment. —A. R. D.

	Initial Point of Fusion of the Fat.	Percentage of Fatty Acids Insoluble in Water.	Initial Point of Fusion of Insoluble Fatty Acids.	Concluding Point of Fusion of Insoluble Fatty Acids.
Genuine Cows'-milk Fat	34—35° C.	87·77%	42—43° C.	45—46° C.
Sesame Oil	Fluid.	95·86	25—26	29—30
Cotton-seed Oil................	,,	95·75	39—40	42—43
Olive Oil	,,	95·13	23—24	26—27
Refined Rape Oil..............	,,	95·14	18—19	21—22
Earth-nut Oil...................	,,	95·86	31—32	34—35
Cacao Fat from—				
Maracaibo Beans..........	25—26° C.	94·59	48—49	51—52
Caraccas ,, ...	27—28	95·31	48—49	51—52
Trinidad ,, ...	26—27	95·65	49—50	52—53
Portoplata ,, ...	28—29	95·46	49—50	52—53
Machala Guayaquil Beans	28—29	95·24	49—50	52—53

—E. G. C.

Improved Composition for Painting Railway Signals. Horace Wilmer and Thomas Bolas. Eng. Pat. 10,624, July 26, 1884.

THE patentees use a spirit varnish similar to the "sealing-wax varnish" used for electrical purposes, and produced by dissolving shellac (seed lac, button lac, or stick lac) and Burgundy pitch in alcohol, wood spirit, or the mixture of the two known as "methylated spirit," and incorporating vermilion in the solution. The proportions recommended are—

Lac	1000	parts by weight.
Alcohol	1530	,, ,,
Burgundy Pitch	200	,, ,,
Vermilion	800	,, ,,

—H. R. P.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Preliminary Note on the Synthesis of Tannin. Bertram Hunt. Chem. News. **52**, 49.

IT having been shown, lately, by Böttinger and others, that Schiff's digallic acid differs from gallo-tannin, and is probably only isomeric with it, it occurred to the author that possibly gallo-tannin might be produced by the action of mono-bromo-protocatechuic acid on potassic gallate. The reaction may be represented thus:—

$$C_6H_2(OH)_3COOK + C_6H_2Br(OH)_2COOH = C_6H_2(OH)_3CO.O.C_6H_2(OH)_2COOH + KBr.$$

The experiment was made as follows:—Mono-bromo-protocatechuic acid was prepared by the action of excess of bromine on protocatechuic acid in the cold ("Watt's Dictionary," vi. 976). Potassic gallate—

$$(2C_7H_5KO_5.C_7H_6O_5 + H_2O)$$

was prepared according to the directions given in "Watt's Dictionary," ii. 761.

The bromo-protocatechuic acid and potassic gallate were cohobated together on the water-bath for about five hours, in presence of absolute alcohol, a slight excess of potassic gallate being used. The cold liquid was filtered through fine asbestos, and the alcohol evaporated off at a low temperature. The residue was dissolved in aqueous ether, and the solution filtered through asbestos. The ether was now evaporated off, and the residue dissolved in cold distilled water. The filtered, brown-coloured solution gave the following reactions:—It precipitated gelatin solution. It precipitated cupric acetate solution, and the precipitate was insoluble in ammonic carbonate. It gave a precipitate with tartar emetic solution in presence of ammonic chloride. It gave a black colour with ferric chloride, and, on standing some hours, a slight black precipitate. It reduced Fehling's solution readily on boiling. It precipitated cinchonine sulphate solution. The cinchonine precipitate was washed and carefully dried. The amount of cinchonine in it was determined by dissolving a weighted quantity in dilute sulphuric acid, boiling, and then precipitating the cinchonine in the cooled solution by a slight excess of caustic soda. The result was 31·56 per cent. cinchonine in the dry precipitate. $C_{20}H_{24}N_2O.2C_{14}H_{10}O_9$ gives 32·353 per cent. cinchonine.

These reactions are identical with the reactions of gallo-tannin, and are not given by either gallic or protocatechuic acid, or by a mixture of these acids. Further experiments are of course required to prove the identity of the substance produced with gallo-tannin.—W. S.

Improvements in the Manufacture of Substitutes for Leather. Maximilian Zingler. Eng. Pat. 3171, February 12, 1884.

A COMPOSITION is made consisting of gum-percha 3½lb., powdered waste rubber 3½lb., indiarubber 7lb., sulphuret of antimony 3lb., peroxide of iron 1lb., flower of sulphur 1¼lb., lime 2¼lb., asbestos powder 4lb., sulphuret of zinc 1½lb., carbonate of magnesia 3½lb. By gum-percha is meant the gutta-percha substitute described in Patent 1153, March 9, 1882. This mixture is worked through mixers, or iron rollers, and then vulcanised in a vulcanising press at 280° F., for an hour or more. This is to imitate heavy leather; for light, solid leather, powdered wood fibre, nut shells, or cuscus root is substituted for asbestos. Machine belts are prepared by soaking canvas in a bath of tannin and potash or ammonia alum, or tungstate of soda. It is then drained and steeped for twenty-four hours or more in a bath of sulphate of zinc, drained and allowed to dry. It is then coated with the composition above described, but without the waste rubber, and either dissolved in naphtha or worked up to a soft state between rollers. The canvas is doubled from two to twelve plies, and vulcanised for ½ to 1½ hour; for leatherine, canvas or calico, prepared as above described, is coated with a composition of indiarubber 7lb., substitute (as mentioned in Patent 242, January 15, 1883, under the heading of oxidised oil), 2½lb., sulphuret of antimony 3¼lb., peroxide of iron 1lb., sulphur ¾lb., sulphuret of zinc 2¼lb., carbonate of magnesia 5½lb., sulphate of baryta 2lb. This is vulcanised for half-an-hour, cooled, and if necessary again vulcanised. Thin leatherines are treated with a thin coating of indiarubber solution before applying the composition.

—H. R. P.

A Substitute for Whalebone, Steel, etc., for Stiffening Corsets, etc. Jas. Royle. Eng. Pat. 4578, March 8, 1884.

THIS consists in strips of buffalo hide, which (presumably first unhaired by liming in the usual way) are softened in cold water. They are then cut to required form, and dried in a current of cold air. After smoothing with pumice, they are rubbed on both sides with palm oil, to give the requisite elasticity, and again allowed to dry. They may be hammered or rolled to increase firmness, dyed black or otherwise, and polished or varnished.—H. R. P.

XIV.—AGRICULTURE, MANURES, Etc.

Influence of Malt-dust, and the Non-albumenoid Nitrogenous Compounds contained in it, on the Yield of Milk from Cows. M. Schrodt and H. Hansen. Bied. Centr. **14**, 246—248.

THE experiments were arranged in three periods of twenty-five, thirty, and twenty-five days respectively. In all three the quantity of nutritious matter supplied in the fodder was approximately the same. In the first and third, or normal periods, the rations consisted of clover-hay, oat-straw, roots, wheat-bran, and cotton-seed cake, whilst in the second, or experimental period, the clover-hay and bran were in part replaced by malt-dust, the normal proportions of nutritious matter being sustained by slightly increasing the quantity of roots, straw, and cake, with the addition of starch and olive oil to equalise the carbohydrates and fat. This fodder, rich in nitrogen as amides, produced a slight increase in the total yield of milk, but the quality was rendered slightly inferior, inasmuch as the production of dry matter and fat suffered a very slight depression. It would appear, therefore, that the nitrogen as albumenoids in fodder may be replaced, to a certain extent, by nitrogen as amides, without exerting any noteworthy injurious influence either on the quantity or quality of milk.—D. A. L.

Composition of Alpine and Valley Hay. W. Eugling. Bied. Centr. **14**, 250—252.

ANALYSES of hay from various localities show that neither the height at which it is grown nor the character of the soil have much influence on the composition of the hay. The author, however, remarks that hay grown at a height of from 1200—1400 meters, has a lower percentage of fibre and ash than that grown in either higher or lower districts, whilst the quantity of albumenoids is greater in the hay from high than from low localities.

—D. A. L.

Beet-nematoids in France in 1884. A. Girard. Bied. Centr. **14**, 262—263.

When the roots are attacked by these parasites (chiefly the variety *Heterodora Schachtii)* the leaves wither suddenly, become yellow, then develop reddish spots, finally turn quite black and fall off. Moreover, the yield of sugar suffers a very considerable reduction. (See also *Compt. Rend.* 99, 922.)—D. A. L.

Percentage of Alkaloïds in different Varieties of Lupins. E. Hiller. Bied. Centr. **14**, 263.

The author has examined ten varieties of lupins, and tables are given showing the percentage of solid and liquid alkaloïds in each variety. *Lupinus luteus* (yellow lupin) heads the list with a percentage of 0·65 of total alkaloïds, whilst *L. hirsutus* (blue lupin) closes it with 0·04 per cent. of alkaloïds. It is noteworthy that *L. hirsutus*, with this mere trace of alkaloïds, has not a bitter taste. Both the author's and Täuber's results indicate that with regard to the quantity of alkaloïds they contain, the individual varieties nearly always bear the same relation to one another.—D. A. L.

Composition of Horse-Chestnuts, J. Hanamann. Bied. Centr. **14**, 263—265.

The author has analysed horse-chestnuts from various localities, and grown on six soils of different characters. The composition of horse-chestnuts varies to some extent, and the following figures represent the maximum and minimum amounts per cent. of the constituents :—

	Water.	Albumenoids.	Fat.	Matter Convertible into Sugar.	Ash.
Maximum ..	10·27	8·75	7·07	76·39	2·51
Minimum ..	7·08	6·56	5·08	72·94	2·17

	P_2O_5	K_2O	CaO	SO_3	MgO
Maximum (per cent. of ash)	28·12	62·06	6·82	3·18	6·32
Minimum „ „	22·49	57·22	3·26	1·78	5·40

Chlorine and silica are present in very small quantities, and sodium, iron, and manganese only in traces. Nutritive value is 1:7. The highest per cent. of albumenoid is found in the horse-chestnuts grown on soil poor in lime, and *vice versâ*, whilst the highest amount of fat is found in the nuts from a soil of basalt origin. The horse-chestnut, like the edible chestnut, appears to thrive well on silicious soils poor in lime.—D. A. L.

Nitrogen in Leather Waste. R. Dauguy. Bied. Centr. **14**, 278.

Analyses of various samples of leather from different localities, etc., gave the following percentages of organically combined nitrogen :—

Bullock hide salted in America, tanned in France ..	6·45
Bullock hide from France	5·43
French cow hide	6·87
White skin refuse from Paris	5·96
Calf tanned black by German process	5·01
Calf cured in Paris	5·75
Calf tanned white by German process	5·98
French horse hide	4·41
Sheep-skin cured in Paris	4·00
Levant goat-skin, black grained, English manufacture	3·57—3·42
„ „ white „ „ „	4·87
Russian kid, black glazed	4·83
„ „ light yellow	4·31

—D. A. L.

Cause of Reversion of Phosphoric Acid in Superphosphates containing Potassium Salts. Schucht, G. Loges and A. Emmerling. Bied. Centr. **14**, 278—280.

From observations made with mixtures of superphosphates with samples of calcined Stassfurt salts, both in presence and absence of iron, the authors conclude that the reversion of phosphoric acid in such mixtures is caused by magnesia. A sample of calcined Stassfurt used in their experiments was found, by titration with acid, to have alkalinity equivalent to 2·05 per cent. of free magnesia.—D. A. L.

Sesame Cake as Cattle Food. A. Ladureau. Bied. Centr. **14**, 281.

The author recommends sesame cake as a partial substitute for linseed cake. A specially pure sample of sesame cake contained per cent. :—

Moisture	12·54
Nitrogenous matter	38·93
Fat	9·60
Starch, dextrin, glucose	3·07
Pectinous substances	12·09
Cellulose	10·57
Calcium phosphate	5·20
Calcium carbonate and sulphate	4·62
Potassium and sodium salts	0·36
Silica, iron oxide, and insoluble silicates	3·06
	100·04

—D. A. L.

Presence of Manganese in Plants, etc. Maumené. Bied. Centr. **14**, 283—284. (Compare this Journ. 1884, 528.)

In addition to facts already published (*loc. cit.*) the author has found 0·002 gram of manganese per litre in a sample of Pomard's wine, and only 0·0003 gram of an Algerian wine. Cereals contain $\frac{1}{15000}$ to $\frac{1}{5000}$ of manganese ; rye, rice and barley each containing about the same quantity. Manganese has been detected in potatoes, sugar-beet, carrots, cocoa, coffee, tea, and tobacco, the ash of tea containing the largest quantity. The green colour of seed-ashes is attributed to this metal. Manganese is not always present in the blood, but is found in very small quantities in milk, urine, in bones and hair, and in comparatively large quantities in fæces.—D. A. L.

Yellowness of Vines. J. Nessler. Bied. Centr. **14**, 286.

In vineyards there are frequently some vines with yellow leaves. This yellowness is due to insufficient nutrition, and therefore the affected plant cannot thrive. It may be cured by a liberal dressing of quick-acting manure. For this purpose liquid manure mixed with 1lb. of ferrous sulphate (dissolved in water) per hectolitre is recommended ; holes are dug round the vine, and the manure is poured in them.—D. A. L.

Sprouted Barley. F. Farsky. Bied. Centr. **14**, 287.

The author's experiments with chevalier barley and rain-water lead him to the following conclusions (compare Behrend, this Journal, iv. 412—413). When barley is soaked in rain-water for a sufficiently long time, it germinates, and at the same time fermentation sets in, producing a change in both the nitrogenous and non nitrogenous constituents of the grain, consequently there is a loss by solution in the water of some of these substances, as well as of some of the original soluble constituents of the grain. This loss is not as great as the loss connected with the actual germination of the barley. If, however, the action of the water be continued until sprouting is complete, then two other processes ensue ; the one determines the decomposition of albumenoids, more especially the insoluble varieties, with the evolution of ammonia ; whilst the other works the destruction of the fat, and an alteration of the woody fibre. The effect on the product is different in both cases, and is evinced not only in altered composition, but under some circumstances, in loss of germinating power ; when, in other words, the sprouted grain becomes useless for brewing purposes. In the author's experiments, 10 per cent. of the steeped barley was rendered useless in this way.
—D. A. L.

Agricultural Value of Sewage. Kiepert. Bied. Centr. **14**, 309—311.

The following results relate to the effects produced by manuring certain fields and meadows with Berlin sewage. On meadow land there is an increase in the yield ; Italian rye grass alone or mixed with Timothy grass (cat's tail)

yields 4 to 5 or even 6 cuttings of 1 to 1½ foot high, whilst in other meadows 3 cuttings of broad-leaved grasses are taken. The rye grass, according to the author, forms excellent fodder for bullocks, milking cows, sheep, horses, and even pigs; it is very succulent, and takes a long time to dry; the haymaking is therefore conducted on a fallow or stubble field, so as not to interfere with the new growth in the meadow. Mangold-wurzel give very good results with not a single bad harvest in 8 years; with sugar-beet, on the other hand, the results are not so satisfactory. White carrots yield well, and chicory gives as much as 783centnr. per hectare. All kinds of vegetables have been cultivated with the sewage as manure, they grow to a very great size, but only red and white cabbage are at present cultivated on a large scale. Large yields are obtained with hemp, which grows so thick as to drive out all weeds, and also with rape and turnips, which are useful crops, as they take up the manurial matter in the subsoil. Rye, wheat, summer rye, and oats have all been cultivated, and barley to a small extent. Irrigation experiments were also made; in September 1175—1565cm. of sewage water were applied per hectare. In one case rye was sown broadcast in October, and yielded the following August 395kilos. of grain, and 878kilos. of straw per morgen (= 0·2553 hectare). In another field, which had grown in the previous year barley after potatoes, chevalier barley was sown in the April after irrigating, throve well, and yielded 508kilos. of grain and 1235kilos. straw per morgen (= 0·2553ha.). A bushel weighed 34kilos. In another field, previous cropping had been barley after manured potatoes; oats were sown in April, the plant did well, and yielded 445kilos. of grain and 965kilos. of straw per morgen. The weight per bushel was 23·5kilos. The author recommends the use of sewage-water for agricultural purposes.—D. A. L.

Manurial Experiments. J. König. Bied. Centr. **14**, 319—320.

In various experiments, land which had been exhausted with the growth of lupins was much benefited by manuring with kainite, or, better still, with kainite along with nitrogenous and phosphatic manures, the crop being rye after the lupins; on the other hand, with phosphatic and nitrogenous manures without kainite the beneficial result was doubtful. In other experiments similar results were obtained with these manures with potatoes grown on a species of slatey deposit (Grauwacken-schiefer). Moreover, kainite exerted a favourable influence on potatoes receiving lime and liquid manure, and on meadow land manured with superphosphate; in this case the first crop was about the same with or without the kainite, but the aftermath was stronger with the kainite, and contained a considerable quantity of red clover and bird vetch. Experiments with potatoes show that potatoes manured with superphosphate and sodium nitrate yield better in most cases than potatoes manured with the same weight of nitrogen and phosphoric acid as bone-meal, although more bad tubers are always harvested in the former than in the latter case. Quick-acting manures should be used instead of bone-meal on lands where the period of vegetation is short.
—D. A. L.

Artificial Manures for Vines. A. Stutzer. Bied. Centr. **14**, 321—322.

Whilst the cost is about the same, the leaves and wood develop better and the yield of grapes is greater when the vines of black grapes are manured with artificial, than when they are treated with stable manure; the quantity of sugar and acid in the most is not apparently affected by the change of manure. With white grapes the experiments with artificial manures have not been successful, which the author considers is due to the manures not reaching the deep roots of the vines. The manure is composed of 6 per cent. phosphoric acid, 6 per cent. of potash as sulphate, 3 per cent. nitrogen (as ammonia or nitrate). Nitrate is best for vineyards with deep soil.
—D. A. L.

Peat Litter as Manure. Wagner. Bied. Centr. **14**, 352.

Comparative experiments with peat-litter manure, and straw-litter manure, show that the former is better than the latter for potatoes and oats. For barley they are about equal in value.—D. A. L.

Phosphates for Sugar-beet. A. Ladureau. Bied. Centr. **14**, 361.

The present experiments show that precipitated phosphate and superphosphate are about equal in value as manures for sugar-beet, when employed in the quantities used by the author, which, in the case of both manures, were equal to 100, 200, 300, and 400kilos. of phosphoric acid per hectare in the various experiments respectively. The phosphatic manures give rise to a decided increase in the yield, which generally is moderately uniform, but is highest with the 200kilos. of phosphoric acid as superphosphate. The author regards the application of more than 100kilos. of phosphoric acid per hectare as useless.
—D. A. L.

Manurial Experiments with Hops. C. Kraus. Bied. Centr. **14**, 362—366.

The author finds that under favourable climatic influences the application of artificial manures, more especially superphosphate and sodium nitrate, exerts a beneficial action on hops. On the other hand, no advantage was derived by such applications in unfavourable weather. Contrary to expectation, a better yield per stock was obtained when three than when two hop bines were trained on the same pole.—D. A. L.

Maize Silage as Fodder for Milch-kine. Rose. Bied. Centr. **14**, 374—375.

Maize (sour) silage from chopped green maize, put in the silo on 16th September, was given as fodder on 11th October. The rations per cow were 30kilos. of maize silage mixed with one-twelfth its weight of chaffed straw, 1·5kilo. oil-cake, 0·5kilo. wheat-bran, 50grm. common salt, and 20grm. of basic calcium phosphate, the last constituent to correct the laxative properties of the silage. With this fodder the yield of milk increased and the butter was yellow and had a good taste. Ewes in lamb fed with this silage received 0·63kilos. per head. Müller deems it advisable to allow the silo to cool considerably before feeding maize (sour) silage. The temperature in a silo filled by Goffard's method after six weeks was 30° C., and after eight weeks 27·5° C. Souring and heating always ensue. Klein found 2 per cent. of acetic and lactic acids in three samples of maize (sour) silage, and did not observe any considerable increase in acidity during its exposure to the air in removal, etc.
—D. A. L.

Manurial Value (for Barley) of various forms of Phosphates. Fittbogen. Bied. Centr. **14**, 313—318.

Experiments were made with barley in pots in ignited levigated sand. Each pot received 4kilos. of sand, 6 barley plants, and a mixture of 3mllgrm. molecules of potassium chloride, 0·8mllgrm. mol. of magnesium sulphate, 0·8mllgrm. mol. of calcium nitrate, and 1 (or more) mllgrm. mol. of phosphoric acid in some form or other.* Preliminary experiments showed that with one mllgrm. mol. of monocalcium phosphate the result was slightly superior to that obtained by cultivation in garden soil, and much superior to the yield of field cultivation; whilst the disastrous effects of diminishing the quantity of phosphoric acid added were also distinctly indicated. Hence the above mode of investigation by sand cultivation was proved to be quite sufficient for testing the manurial value of various kinds of phosphates. For application soluble phosphates were dissolved in water, insoluble phosphates were mixed with

* These quantities of phosphoric acid being regulated according to the recognised value of the phosphates as manures.

soil; in many cases water saturated with carbonic anhydride was employed, and in other experiments humic acids or calcium humate were added to the sand, etc., in the pots. Nine varieties of phosphates were investigated, and a table of results is given. The following table, an extract from the table mentioned, shows the effect of one mllgrm. mol. of phosphoric acid (=0·142grm. per pot, corresponding to 72kilos. per hectare) in different forms, and under varied conditions:—

Manuring with 1 mil. Mol. of Phosphoric Acid as under.	Dry Matter in Produce per Pot. Grms.	Total above-ground Growth. Grms.
Mono-calcium phosphate dissolved in water	10·13	20·91
„ „ with calcium carbonate	10·10	21·19
Di-calcium „	9·91	20·53
Tri-calcium „	0·80	3·18
Iron „	1·65	4·93
„ „ with humic acids	3·77	11·01
Aluminium „	4·17	10·20
Mejillos ground superphosphate	9·50	20·88
„ „ „ dissolved in water	9·70	21·26
Lahn superphosphates	3·41	8·04
„ „ dissolved in water	6·81	14·76
„ „ with carbonic anhydride water	3·48	8·31
Precipitated calcium phosphate (Wilhelmsburg)	10·04	18·37
Cladno phosphate	2·00	6·88
„ „ with carbonic anhydride water	3·01	7·31
„ „ with humic acids	7·01	13·77

Thus normal or good yields were obtained with the one mllgrm. mol. of phosphoric acid per pot (=72kilos. per hectare) when applied as mono-calcium phosphate, as Mejillos superphosphate, as di-calcium phosphate, and, as regards the grain, with precipitated phosphate. Increasing the quantity of phosphoric acid applied in these four forms to 2mllgrm. mols. or to 3mllgrm. mols., in the case of the precipitated phosphate did not produce any considerable increase above the normal yield. The absorptive capacity of sand for phosphoric acid is very small, hence the soluble phosphates when applied to the sand were not altered, and this may account for their activity; but even the addition of 0·5 per cent. of calcium carbonate, which increased the absorptive power of the sand, did not reduce the yield. The 6 plants harvested from three of the above experiments contained the following amounts of phosphoric acid:—From the mono-calcium phosphate pot, 0·0587grm.; from the di-calcium phosphate pot, 0·0554grm.; from the precipitated phosphate pot, 0·0488grm.; thus, by means simply of root-activity, even some insoluble phosphates are made to give up the quantity of phosphoric acid required by the plants. Lahn superphosphate and tricalcium phosphate, when used alone, had to be employed in quantities equivalent to 2mllgrm. mols. of phosphoric acid per pot in order to obtain normal yields of barley; whilst the other phosphates enumerated above do not yield normally, even under these favourable circumstances. The addition of humic acids or calcium humates improves the state of things to a very marked extent, for under these conditions (humic acids) 2millgrm. mols. of phosphoric acid as Lahn superphosphate give the greatest yield of all the experiments; and even Cladno, iron, and aluminium phosphates are awakened to a reasonable amount of activity. The author hence concludes that humic matter is the most important and perhaps only medium which aids the assimilation of phosphoric acid from very insoluble compounds. The author divides phosphatic manures into three groups:—1. Phosphates of greatest activity or most rapid action, such as mono- and di-calcium phosphate, precipitated phosphate, and good superphosphate (from guano, bone-ash, pure apatite, etc.). 2. Phosphates of medium activity, such as tri-calcium phosphate and superphosphates from inferior materials. 3. Phosphates slow in action, such as iron, aluminium and Cladno phosphates. To produce the same effect as a superior fertiliser, an inferior phosphate must be used in proportionately larger quantities, and should therefore cost proportionately less. Field experiments in the same direction have also been conducted, and confirm the results from the pot experiments. Treating with carbonic anhydride water was found to be useless for increasing the activity of insoluble phosphates. The phosphates employed were chemically pure preparations. The phosphoric acid in the superphosphates, etc., was in the following condition:—

	Water soluble.	Citrate soluble.	Total.
Mejillos guano superphosphate	19·48	1·73	21·71
Lahn superphosphate	4·13	5·83	18·84
Wilhelmsburg precipitate	0·33	11·12	28·85
Cladno phosphate	—	6·68	11·36

—D. A. L.

Injurious Effect of Hydrochloric and Sulphurous Acid Vapours on Vegetation. J. König. Bied. Centr. **14**, 418—419.

In a forest exposed to hydrochloric acid vapour the leaves had a sickly appearance similar to that induced by sulphurous acid. The injured oak leaves contained 0·084—0·104 per cent. more chlorine than healthy oak leaves from same forest, whilst in the sickly beech leaves this excess of chlorine was 0·128—0·153. Oats exposed to sulphurous acid vapours, from coke-ovens, etc., were seriously injured and yielded badly; 1000 grains of injured oats weighed only 11·79grm., whilst 1000 grains of healthy oats from another part of the same field weighed 25·30grm. The injured straw contained 1·080 per cent. in dry matter, or 17·22 per cent. in ash, of sulphuric acid in excess of that contained in the uninjured oat straw, whilst the proportion in excess in the grain was 0·308 per cent. dry matter or 6·67 per cent. ash, thus showing without doubt that the sulphurous vapours were the cause of the mischief.—D. A. L.

Pasture Feeding in Oldenburg. H. C. Tantzen. Bied. Centr. **14**, 424—425.

THE following figures show average results of pasture feeding in 1884 :—

	Average weight in kilos.		Increase in kilos.			Days in pasture.
	Before feeding	After feeding.	Highest.	Lowest.	Average.	
3-year old bullocks	505	705	266	106	200	155
2-year old bullocks	411	641	290	195	230	198
Cows	582	723	245	135	191	171

Forty-seven three-year old bullocks required 23 hectares of pasture for the production of 9402kilos. of flesh, and the cost of production was 18·30 marks per 50kilos. live weight. The two-year olds cost about the same; whilst the cows cost 17·35 marks for every 50kilos. live weight produced. Some of the cows calved in January, hence their average increase is rather low.—D. A. L.

Temperature Requirements of the Vine. Roger. Bied. Centr. **14**, 426.

THE following figures are the means of nine years' observation. Vine shoots open as soon as the mean day temperature exceeds 11° or 12° C. Leaf development begins at a mean temperature of 13·6° C., and a mean of 27·5° of rain. From the opening of the shoots until the blossoming, 25 to 32 days intervene, when a mean aggregate temperature of 466° C. is necessary, and from the blossoming to the maturing the grapes require 1926° of heat daily; thus the mean temperature during these 104 to 115 days should be 14·7° C. If the temperature stands below 12·5° during this period, the ripening is interrupted. The mean temperature for the last 20 days of the growth of the grape is 17° C.—D. A. L.

XV.—SUGAR, GUMS, STARCHES, Etc.

Proposed Nomenclature for Sugars. C. Scheibler. Rep. Anal. Chem. **5**, 185.

THE names customary hitherto have not exhibited the division of sugars into the two great groups of which the formula $C_6H_{12}O_6$ and $C_{12}H_{22}O_{11}$ are types. The author proposes to retain the affix *ose* only for the group $C_6H_{12}O_6$, thus—Dextrose, lævulose arabinose, cerasinose, lactose (galactose), sorbin, eukalyn, inosite, dambose, mannitose, etc., and to use the ending *biose* for the invertible sugars of group $C_{12}H_{22}O_{11}$. Hence we should have :—

Saccharobiose	for	Saccharose.
Trehabiose (mykobiose)	,,	Trehalose (mykose).
Meletibiose	,,	Melizitose.
Melibiose	,,	Melitose.
Maltobiose	,,	Maltose.
Laktobiose	,,	Galactose (lactose).

Milk sugar being termed by some writers galactose and others lactose, this causes confusion. The sugar $C_{12}H_{22}O_{11}+H_2O$ would be lactobiose, and its inversion product lactose. To avoid confusion in the case of arabinose, the author proposes "arabose" as a substitute.—H. A. R.

Estimation of Moisture in Starch. L. Boudonneau. Rep. Anal. Chem. 14, 222.

FROM 5 to 10grm. are placed in a drying chamber, the temperature of which rises within three hours to 60° C., and then during one hour to 100° C., and dried until the weight is constant. If the starch be acid, it is dried at 60° C., mixed with its own weight of distilled water and 1 to 2 drops of ammonia, dried again at 40° C., and finally submitted to the desiccating process already described.—E. G. C.

Presence of Potassium and Calcium Salts, etc., in Sugar, Beet and Maize. H. Leplay. Bied. Centr. **14**, 258—259.

IN a former communication the author has shown that potassium and calcium are taken up as carbonates by the roots of sugar-beet during their growth, subsequently these bases are found in all parts of the plant as soluble organic salts; but as the tissue develops the lime becomes insoluble and is deposited. In fact, the amount of sugar formed in the root is in direct proportion to the quantity of lime thus stored up in the plant. The potassium salts, on the other hand, accumulate in the leaves. The author has extended his experiments to maize, and has observed a similar sequence of phenomena. As maize matures in one year, these observations extend farther, and the author shows that the potassium salts accumulate in the leaves until the ears begin to form; they then migrate to the stem, thence by the stocks to the ears, and finally to the seed. Sugar plays an active part in these migrations, and both lime and potash are in maximum quantities in the leaves and stem when the sugar in these parts is at its maximum, and they are present in the seed in greatest quantities when the starch has reached its maximum. An increase of starch in the seed is always accompanied by a corresponding decrease of sugar in the stem.—D. A. L.

Formation of Gum in Wood, and its Physiological Signification. B. Frank and F. Temme. Bied. Centr. **14**, 285—286.

THE authors state that the formation of gum in leaved trees takes place both in the wood vessels and cells, and also in the sap channels. Inasmuch as whenever and in whatever part of the plant a wound is made, there gum is sure to be found. From numerous observations they conclude that the function of gum in leaved trees is similar to the function of resin in conifera. The gum, in fact, serves to protect the wood beneath a wound from the action of air and water, and is found in all wounds whether caused by the falling of leaves, or ravages of insects, or frost, etc.—D. A. L.

Preparation of Sugar from Beet without employing Sulphurous Acid, Animal Charcoal and Gravel. R. Schmidt. Bied. Centr. **14**, 286.

LIME and carbon-dioxide are alone used. No difficulties are encountered, and the yield and quality are good. (See *Deutsche Zucker-ind.* 10 Bd. 1885 [1], 9—10.)—D. A. L.

Improved Method of Decolorising and Clearing Beet Juice by the Lime Process. G. Fritsche's Patent. Bied. Centr. **14**, 286.

0·4% TO 0·6% of clay is taken for each 2½% to 4% of lime employed. The lime and clay are mixed with water, warmed, and boiled up with the juice. The whole is allowed to subside, and is decomposed with carbonic anhydride, etc. Many impurities are precipitated with the clay.—D. A. L.

Preparation of Sugar and Purification of Beet Juices by means of Solutions of Magnesium and Aluminium Hydroxides. Jünemann. Bied. Centr. **14**, 358.

ALUMINIUM hydroxide is dissolved in solutions of aluminium chloride or sulphate, and dialysed until free from chlorine or sulphuric acid. The solution of aluminium hydroxide prepared in this manner yields almost perfectly pure sugar juices. Magnesium hydroxide solutions form granular crystalline magnesium saccharate insoluble in water, with hot sugar juices. (Compare this vol. 461).—D. A. L.

Drying Beet Cuttings. Märcker and H. Schultze. Bied. Centr. **14**, 358.

THE cuttings from the presses are mixed with 1·5 per cent. of lime, as milk of lime; they are then reduced by pressure to 25 to 30 per cent. of dry matter, and are finally dried in a kiln—D. A. L.

Shaded and Unshaded Beets. B. Lach. Bied. Centr. **14**, 394—396.

BEETS grown in the shade and in the open field were examined throughout the period of their growth from the middle of August to the end of October, from which observations it is evident that dry hot weather under certain circumstances increases the quantity of sugar in the shaded beets, or in beets cultivated in low and very damp ground. The yield from shaded beet plants is always less than from those not in the shade, although the quality is not inferior.—D. A. L.

Improvements relating to Apparatus for treating Ligneous Substances for the Production of Glucose. H. H. Lake, London. From A. F. Le Mye, and W. de Peyster, Paris. Eng. Pat. 11,407, August 18, 1884.

THE improvements herein described are more especially applicable to the "Dangiville" process, in which gaseous HCl is employed to act upon cellulose or woody fibre for the formation of glucose. An annular column is used in which the cellulose is placed; the gaseous HCl is admitted from a main at several points; the annular space at such parts being enlarged to secure the distribution of the gas. The top is made funnel-shaped so as to be more convenient for the introduction of the material; the whole apparatus is kept cool by a stream of water. The operation is completed by washing out the unconverted woody tissue in the same column by a shower of water. The patentee claims considerable economy of time and material.—C. C. H.

Improvements in the Manufacture of Sugar and in Apparatus therefor. W. R. Lake. From F. O. Matthiesen, U.S.A. Eng. Pat. 6432, May 26, 1885.

THE object of this invention is the cheap and rapid production of hard white crystalline sugar in the form of cubes or loaves. The process consists essentially of transforming into the above so-called hard sugars, various soft or granulated sugars, especially those known as "A" coffee sugars and "granulated sugars"—which soft and granulated sugars can themselves be prepared from sugars of comparatively low grades by one refining operation. The soft sugars are fitted into moulds of shapes and sizes which vary according to the particular form in which it is desired to obtain the final product. They may be previously dried or they may contain a certain amount of moisture, and they are then treated with a hot concentrated solution of white sugar, which on cooling cements the whole mass together by means of the sugar which crystallises out from the cooled solution. When thoroughly cooled, the mass is drained either by centrifugal or other means, and dried at a comparatively low temperature. The sugar produced has a peculiar glistening appearance, due to the presence of small sugar crystals, not only on its exterior, but also upon its planes of cleavage when broken. The charging of the sugar with "white liquor" may if preferred be performed in an air-tight chamber, from which when charged with sugar the air is exhausted before admitting the liquor. The temperature of the "white liquor," and also of the soft sugar to be operated upon, varies with the nature of the final product required; but the temperature of the "white liquor" may be as high as 220° F., or even higher. As by this method soft or granulated sugars or mixtures of the two are transformed into cakes of hard sugar by a process of cementation by crystallisation, the product of the process is designated "double crystallised sugar." Full descriptions of various kinds of plant and apparatus for carrying out the above process are given, with numerous diagrams.—A. J. K.

Improvements in the Manufacture of Starch, Glucose and other Starch Products. A. M. Clark, London. From the Davenport Glucose Manufacturing Co., U.S.A. Eng. Pat. 6661, June 2, 1885.

IN the ordinary process of preparing starch from corn and other grains it is usually the custom to add caustic soda to the starch milk coming from the separators. Instead of caustic soda the author prefers dilute sulphuric acid. This precipitates the starch milk in the settlers, the liquid containing from 0·1 to 0·2 per cent. H_2SO_4. The acid stops fermentation and putrefaction instantly, and the separation of the solid matter is more rapid than when caustic soda is used; the acid water is drawn off from the starch when it has completely settled, and the latter is once more stirred up with a fresh quantity of 0·1 to 0·2 per cent. sulphuric acid. This liquid is then allowed to flow over the starch planes, where the starch settles in a hard mass nearly free from gluten. The trace of sulphuric acid which is present in starch prepared by this process is no detriment if the starch is to be used for the manufacture of glucose or grape-sugar. In cases where the presence of acid would be injurious, it is neutralised with soda and the alkaline sulphate removed by washing. The advantages claimed for the improved process over the old soda process are (1) increased cheapness of production, (2) immediate stoppage by the acid of fermentatian and putrefaction, (3) no gluten is lost in soluble form, as is the case when soda is used.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

Use of Grape-Sugar in Brewing. Rep. Anal. Chem. **5**, 188.

ALTHOUGH the Imperial German Brewing Tariff mentions grape-sugar as a malt-substitute, and indeed taxes it most heavily of all the brewing materials—viz., 4 marks per zentner—yet the magistrates of Kempen have fined a brewer for using grape-sugar. This judgment, which was confirmed on 4th March, 1885, by the Imperial Court, rests on the following ground. For longer than five years it has been known that impure grape-sugar (the pure being too expensive for brewing) contains substances incapable of fermentation and injurious to the product. Also that when this sugar is used, fusel-oil is eventually formed, which may under certain circumstances cause the beer to become injurious to health.—H. A. R.

On the Chemistry of Wine. R. Keyser. Rep. Anal. Chem. **4**, 145; and **4**, 167.

THE author remarks that, until a more satisfactory basis for the comparison of analyses of wines has been established, we must be contented with such relative results as can be attained with the wines of commerce; and he has collected together a large number of results obtained by him during the year 1883. The processes used were essentially those recommended by the "Society of Wine Analysts." In the sugar determination, 10cc. of Fehling's solution corresponded to 0·05grm. of sugar. For the glycerine estimation, an evaporation-correction of 0·1grm. was allowed for every 100cc. of fluid evaporated, but allowance was also made for any sugar or mineral matter present in the weighed glycerine. A determination of the specific gravity is of little or no value as enabling one to judge of the character of a wine. The analyses of wine given in the author's paper include determinations of the alcohol, extract, ash, total acidity, tartaric acid, sugar, glycerine, phosphoric acid, sulphuric acid, lime, magnesia, and potash. The tables are too long to be included here, and they include analyses of white and red wines from the Palatinate, from Wurtemberg and from the Moselle districts; also of Franconian, Italian, Dalmatian, French and Spanish wines. The author has observed that the average percentages of magnesia and phosphoric acid are considerably less in wines that have been treated with grape sugar during fermentation, according to Gall's process ("Gallisierten Weine") than in those which have not been so treated. The wines examined may be classed in three groups:—1. Completely fermented wines, containing only small proportions of sugar, tannin, and colouring matter; to this class most of the German white wines belong. 2. Wines rich in tannin and colouring matter, and either completely fermented or containing less than 0·6 per cent. of sugar; to this class belong most red wines. 3. Wines containing considerable quantities of unfermented sugar (such as Malaga, etc.).—E. G. C.

On the Nitrogen Compounds in Barley, Malt and Beer Worts. Bungener and Fries. Rep. Anal. Chem. **14**, 222.

THE authors' observations relate to the effect of malting, and the various brewing processes, upon the quantity and quality of the nitrogen compounds present in the grain. The increase of the soluble compounds by malting, the production of peptones at 40°, and the diminution of the same, together with albumenous bodies, upon heating the worts, are treated of in the paper.—E. G. C.

On an Acid present in Hops. H. Bungener. Rep. Anal. Chem. **14**, 222.

THIS acid was extracted from fresh lupulin, 6kilos. of hops yielding over 400grm. of the acid; it was then crystallised, first from solution in warm alcohol, and afterwards from petroleum ether. From the ethereal solution it is obtained in crystals 1cm. long; it is also soluble in water, in all proportions. This body yields a copper compound with acetate of copper; and its character appears to be that of a weak acid, or of an aldehyde. —E. G. C.

Wine Coloured with Magenta. Lepage. Bied. Centr. **14**, 286.

MAGENTA was added to wine in proportions equal to 0·20grm. per litre; after six or seven years this colouring matter could not be detected by any known test, either in the wine or in the deposit. It is hence inferred that magenta undergoes some change by prolonged contact with wine.—D. A. L.

Addition of Yeast. Thausing. Bied. Centr. **14**, 288.

FROM brewing experiments with Vienna draught beer, it is proved that the addition of yeast in quantities ranging from one-third to two-thirds of a litre per hectolitre of wort exerts no noteworthy influence on the duration of fermentation, provided the temperature of fermentation remains the same.—D. A. L.

Barley and Brewing Experiments from Experimental Brewery at Weihenstephan, Lintner. Bied. Centr. **14**, 407—408.

THE following are the results of analyses of the 1883 barley from the Munich Scientific Brewery:—

Description of Barley.	In 100 parts of dry matter. N.	Albumenoids.	P_2O_5.	Starch.	Water.	Germinating Power.
Erding	1·616	10·29	1·003	71·28	8·46	30·80
Unterfranken	1·808	11·29	0·931	59·62	17·81	88·60
Bavarian barley	1·661	10·38	1·017	66·45	16·58	90·10
Franken	1·601	10·00	0·913	66·61	11·82	95·10
Freisinger barley	1·623	11·14	0·951	65·84	12·28	80·15
Moosburg	1·585	9·90	0·930	65·16	12·17	83·14
Langenbaek	1·680	10·50	0·935	65·82	12·67	90·00
Landshut	1·722	10·76	1·031	64·18	13·26	89·20

Brewing experiments were tried with these barleys. The fermentation was normal, but the yield was low, owing to the low germinating power of the barley; and the beer had a characteristic flat taste. Treatment with liquid carbonic anhydride improved the beer considerably in clearness, in taste, and in keeping properties. Carbonic acid has been successfully employed in bottling beer. Finally, the author observes that when barley is cultivated year after year in succession on the same land, without manure, the yield of barley decreases, although its composition does not suffer any important alteration. —D. A. L.

Production of Spirit from Batatus edulis. Bied. Centr. **14**, 359.

100KILOS. of these tubers (sweet potatoes) will yield 12·0 or even 13·4 litres of pure alcohol. The spirit is so pure that it is used for wine and in the manufacture of rum and brandy. When stored, the tubers require protection from light, air, and moisture, and a temperature of 8° to 12°. They contain about 67·50 per cent. of water, 10·20 per cent. of sugar, and 16·05 per cent. of starch. In the red variety there is 5·31 per cent. of sugar, and 0·76 of glucose; whilst the white variety contains 4·09 per cent. of sugar, and 0·63 of glucose. —D. A. L.

An Alcoholic Ferment which does not invert Raw Sugar. S. F. Teixeira. Bied. Centr. **14**, 416—417.

THE various ordinary ferments—mycoderma, saccharomyces—were removed from an Italian yeast by successive cultivations in cabbage-water, containing three per cent. of sugar, with 0·003 per cent. of acid potassium tartrate, and left a new yeast in a state of purity. This new yeast is remarkable for its stability of form, dimensions, and appearance (globular cells three to five-thousandths of a millimeter in diameter) under various conditions of cultivation, and moreover differs from all other yeasts that ferment saccharoses, inasmuch as it does not invert raw sugar. Hence it is suggested that it may be employed to separate glucose and raw sugar from molasses; the former would be converted into alcohol, whilst the latter would remain intact.—D. A. L.

XVII.—(*A*) CHEMISTRY OF FOOD. (*B*) SANITARY CHEMISTRY. (*C*) DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOOD.

Preservation of Milk. F. Hueppe and W. Eugling. Bied. Centr. **14**, 415—416.

BY heating above 100°, the taste, appearance, and digestibility of milk are impaired. Therefore Hueppe recommends heating the milk in steam for forty-five minutes; all bacillus spores will be destroyed, and the milk will be perfectly fit for keeping. The same object may be attained by heating for one hour at 65° to 70° daily for five consecutive days. Eugling remarks that milk preserved in this manner gradually deposits casein containing a notable amount of calcium phosphate; this may be obviated to a certain extent by evaporating the milk to one-third its volume in a vacuum. The following figures show the composition of milk preserved in this manner, without addition of sugar:—

	1.	2.	3.	4.
Fat	10·82	11·25	12·3	13·1
Albumenoïds	10·33	11·00	11·4	11·8
Milk sugar	11·59	12·12	12·6	14·5
Ash	2·01	2·21	2·2	2·3

No. 4 received some benzoic acid.—D. A. L.

On the Examination of Butter. M. Liebschütz. Jour. Amer. Chem. Soc. **7**, 134.

The author has adopted a modification of David's method of saponification by barium hydrate. Twenty grammes of the clarified butter-fat are saponified with barium hydrate, the alcohol is evaporated off, and the excess of barium removed by sulphuric acid, litmus being used as an indicator. The solution is filtered and concentrated to a syrup, but the glycerol so obtained is not pure. Strong alcohol throws down a large quantity of salts; the alcoholic solution is filtered, evaporated in a tared dish, and the residue dried in the air-bath above 100° C., to a constant weight. The still impure glycerine is then burnt, the weight of the ash being deducted from the total weight; the difference is glycerol. Pure butter gives 13·75 per cent. of glycerol by this method; oleomargarine yields 7·0 per cent. The glycerol derived from pure butter gives five per cent. of ash, while that yielded by oleomargarine is only 0·3 to 0·6 per cent.—E. G. C.

Substitutes for Tartaric Acid in Baking Powders. J. Napier. Analyst, 10, 124.

The author refers to the frequent presence of lead in tartaric and citric acids, and in cream of tartar, substances largely used in the manufacture of baking powders; he condemns the use of bisulphate of potash as a substitute, because of its purgative action; and he writes favourably of the acid phosphates of ammonia, potash, and lime, which can be obtained free from lead, and, together with bicarbonate of soda, are excellent producers of carbonic acid.—E. G. C.

(*B*) SANITARY CHEMISTRY.

Natural Purification of Water. F. Emich. Bied. Centr. **14**, 292—293.

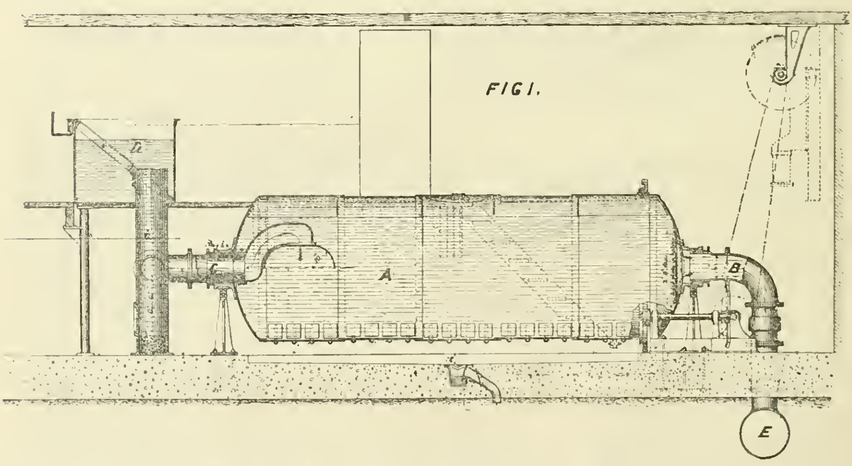
The natural purification of water is shown to be a vital process. Experimental evidence demonstrates that the spontaneous purification of water only takes place when the development of organisms in the water is possible, thus water sterilised by boiling when exposed or agitated with sterilised air undergoes no purification; if, however, it is exposed to or agitated with ordinary air purification proceeds. Other experiments show that perhaps ozone and hydrogen peroxide aid the natural process of purification of water, but at any rate they only play a subordinate part. The author compares the natural purification of water to the formation of nitric acid in the soil. Müller (*Landw. Versuchsstat.* **16**, 263; **20**, 391) has already indicated the probability of the self-purification of water being a vital process.—D. A. L.

The Purification of Water by Means of Iron on the Large Scale. W. Anderson, M. Inst. C.E.; and G. H. Ogston, F.C.S. Proc. Inst. Civil Engineers, vol. 81.

This paper contains a description of the apparatus, devised by one of the authors, for effecting the purification of water by bringing it in contact with spongy iron, as used for purifying the water-supply of Antwerp. The passage of the water through the apparatus is continuous, and the means adopted for ensuring the cleanliness of the surfaces of the particles of iron enables the period of contact of the water and iron to be made much shorter than has hitherto been supposed to be requisite since the method was first proposed by Medlock. Instead of occupying about forty-five minutes, the maximum effect of purification of the Antwerp water is accomplished in 3·5 minutes. The quantity of iron entering into solution is 0·1 grain per gallon; longer contact increases the amount of iron taken up, and does not materially increase the purification. Mr. Ogston has found that the quantity of albumenoid ammonia in different waters is reduced to from one-half to one-third the amount originally present, and the nitrogenous matter remaining behind totally resists the further action of the iron. He further shows that water so purified is practically sterilised, and generally fails to set up putrefactive fermentation in properly prepared solutions of meat extract. Hence he concludes that the nitrogenous matter left in solution is not such as will afford nourishment for the growth and multiplication of germs of infectious disease. The time of contact to secure the maximum amount of purification depends, of course, upon the relative impurity of the water. The apparatus is shown in the drawings on this and following page.

A is a wrought-iron cylinder capable of rotation on its axis, as will be readily understood from the drawing. B and C are trunnions by which the water respectively enters the cylinder from the main E, and delivers into the straining tank D, from whence it is run on to sand

THE PURIFICATION OF WATER
BY MEANS OF IRON ON A LARGE SCALE



filters for the oxidation and removal of the iron taken up. Fig. 2 shows the cylinder in section: during rotation the curved blades at the periphery carry the iron-turnings up to the highest point and discharge them through the body of the water, thus ensuring proper

FIG 2

contact with the water and affording sufficient abrasion to keep the surfaces clean. Working upon fifteen million gallons per day, the cost per million gallons is 9s. 9d., and about twenty-eight pounds of iron are employed per million gallons of water purified.

—C. C. H.

On the Presence of Lead in Glazed and Enamelled Cooking Vessels. H. Fleck. Rep. Anal. Chem. 15, 234.

The author has determined the quantities of lead, yielded by glazed vessels, from different manufacturers, and of varying capacity, to vinegar, of from 4—8 per cent. strength, heated in them for one hour. The results obtained are comprised in the following table:—

Capacity of Cooking Vessel.	Lead dissolved on heating with			Total lead dissolved in the three experiments.
	4 per cent. vinegar.	8 per cent. vinegar.	4 per cent. vinegar.	
I. 725cc.	0·0054grm.	0·0018grm.	0·0032grm.	0·0131grm.
II. 2170	0·0060	0·0066	0·0037	0·0169
III. 1085	0·0172	0·0151	0·0123	0·0416
IV. 1140	0·0062	0·0011	0·0022	0·0125
V. 1045	0·0018	0·0069	0·0043	0·0160
VI. 2550	0·0113	0·0152	0·0108	0·0373
VII. 1520	0·0013	0·0035	0·0009	0·0085
VIII. 1035	—	—	—	—
IX. 1340	0·0046	0·0020	0·0006	0·0072
X. 2450	0·0015	0·0014	0·0007	0·0036

A glance at the above table is sufficient to indicate how differently some glazes behave to others, under precisely similar conditions. The result with the glazed vessel No. VIII., shows that a glaze may contain lead, and yet remain unaffected by vinegar.—E. G. C.

The Effect of the Drought of 1884 upon the Pollution of the River Thames below London. R. W. Peregrine Birch, M. Inst. C.E. Proc. Inst. Civil Engineers, vol. 81.

In a former paper in the same journal the author described a method of calculation now known as the "chlorine method" used by him in 1882 to determine the rate at which the Metropolitan sewage is carried away by the river, and the extent of the sewage pollution. The present paper gives an account of observations made during the drought of 1884. The following conclusions are arrived at. All the fresh water and sewage which had entered the river between Teddington and Southend since June 25 was still there on September 8, and that which had entered on June 16 was still there on August 30. The sewage had remained in the river 45 days, and the fresh water occupied 75 days for its passage from Teddington Weir to Southend. There was less fresh water and more salt water in the river than in September, 1882, and the foul mixture travelled seawards at a much slower rate. The calculations also show that though in time of drought there is more sea water in a tidal estuary than a wet season, its circulation is so slow that its effect as a diluent is greatly reduced. The circulation in November, 1882, a time of flood, was nearly three times as great as in August, 1884, a time of prolonged drought.

—C. C. H.

Action of Water on Lead Pipes. C. Schneider. Rep. Anal. Chem. 10, 158.

The soft water of the river Bober, supplying the town of Sprottau, and although containing only traces of sulphuric acid and calcium salts, dissolves considerable quantities of lead from new lead piping. A new lead pipe, 20 metres long, was filled with Bober water, and left to stand 48 hours; the amount of lead dissolved was found to be 0·502grm. per hectolitre. Difficultly-soluble deposits, which form a protecting layer on the insides of the pipes, are thrown down in a short time, not, however, under a period of 24—26 hours. Hard spring-water (containing in a hectolitre 106·0grm. of non-volatile constituents, 10·5grm. of sulphuric acid, 14·44grm. of chlorine, 11·20grm. of lime, and no inconsiderable quantity of nitric acid) dissolved a quantity of lead amounting to 0·351grm. per hectolitre. The author considers that even a small quantity of carbonic acid, accompanied by dissolved air, is sufficient cause for the solvent action of a water upon lead pipes.—E. G. C.

An Improved Method of Softening Water. P. A. Maignen, London. Eng. Pat. 8745, June 9, 1884.

The softening of the water is effected by the addition of a finely-divided mixture of lime, soda, and alum.

—C. C. H.

Improvements in the Method of Treating Town Refuse, and Furnace and Apparatus therefor. B. D. Healey, Liverpool; and B. H. Thwaite, St. Neots. Eng. Pat. 10,035, July 11, 1884.

This invention relates to improvements in the furnaces commonly called "destructors," used for burning town refuse, and to appliances for the treatment of the products therefrom. The furnace is constructed with a receiving pit at the level of the roadway, a drying chamber with a sloping bottom, and an inclined fire-grate. A hydraulic lift is provided for the elevation of the clinkers, which are removed from the fire automatically by a reciprocating motion given to the firebars similar to that in "Vicar's" mechanical stoker. A condensing

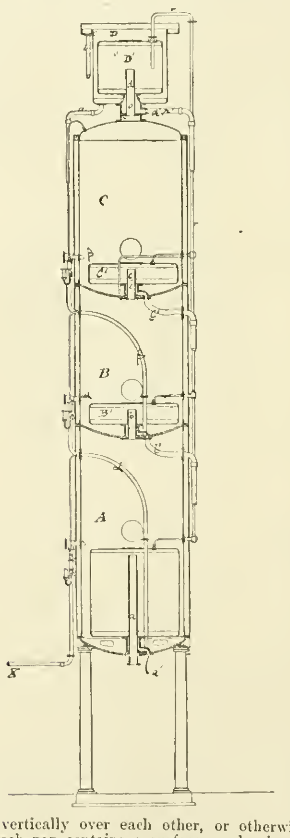
apparatus is placed in the flues so as to obtain useful products from the gases, and to ensure the destruction of all noxious vapours.—C. C. H.

Improvements in Filtering and Treating Sewage. J. Carter, London. Eng. Pat. 10,973, August 6, 1884 (completed April 28, 1885).

THE sewage is collected in a tank or "sewage meter," where it is screened and then precipitated by slaked stone lime, "burned alum," and fine ashes. The mud precipitated is squeezed in long bags horizontally disposed in a suitable press, the bags capable of being opened at both ends. The liquid from precipitation is passed through filtering sacks—C. C. H.

An Apparatus for making Fresh Water from Salt Water. A. Chapman, Liverpool. Eng. Pat. 11,461, August 20, 1884.

THE principle of this apparatus is that of evaporation by multiple effect combined with "evaporation by compression." Three or more closed evaporating vessels are



arranged vertically over each other, or otherwise in series. Each pan contains a surface condensing drum open at the lower part to the atmosphere of the pan below it, as shown in the illustration. Sea water is pumped into the lower vessel A, through pipe X, and exhaust steam from the engine which works the pumps enters the drum A^1, through the pipe a; part of the vapour generated in A is withdrawn by a compression pump and forced into A along with the exhaust steam. Further evaporation takes place in A, and the steam in A^1 is condensed and led away by pipe a^1 to a receiver. By excess of pressure, water from A passes through pipe a into pan B, in which evaporation is effected by drum B^1 heated by steam, entering it from pan A through b. The condensed water in B^1 is led away through b^1. The operation in pan C is similar; water enters from B through pipe β, steam is supplied to drum C^1 through pipe c, and the water condensed led away by pipe c^1. The vapour from C is condensed in drum D^1, situated in condensor D. The condensed water from the three pans passes through a cooler imparting its heat to the cold sea-water fed into the apparatus. The operation in the pans is conducted under reduced pressure by means of an air-pump in connection with the condensor D, and the air thus withdrawn utilised for aerating the fresh water obtained from the pans. The sea-water from the top pan is drawn off by a pump and passed through a heater to a steam boiler which supplies the steam to the whole apparatus. The concentrated water from the boiler is frequently blown off, passing first through the heater, giving some of its heat to the partially evaporated water fed into the boiler, and finally through the cooler above mentioned, where it gives up a further quantity of heat to the cold sea-water pumped into the evaporating pans. Little or no heat therefore escapes from the system. The patentee claims the general construction and combination of the apparatus described.—C. C. H.

Improvements in the Preparation of Agents to be used in the Treatment of Sewage, etc., and Improvements in the Treatment of such Matters. E. J. Leveson and J. W. Slater, London. Eng. Pat. 11,641, Aug. 26, 1884.

"KIMMERIDGE blackstone shale," or any other shale which contains alumina in a form readily soluble in hydrochloric acid, and in addition 15 per cent. or more of carbon, is treated with hydrochloric acid and allowed to stand. The mixture so prepared is used for the defecation of sewage in conjunction with chloride of copper, carbon and clay. In all cases the sewage, if acid, must be neutralised. Precipitation is effected in the usual way in tanks. The claims are—(1) the preparation of the shale, (2) the treatment by the reagents as described.—C. C. H.

Improvements in Apparatus for Purifying Water. W. Anderson, Westminster. Eng Pat. 12,256, September 10, 1884.

THE present invention is to remedy a defect in apparatus for which a former patent was granted.—C. C. H.

Improvements in the Purification of Sewage and other Foul Liquids, and in Apparatus therefor. W. Donaldson, I. Shone and E. Ault, London. Eng. Pat. 12,643, September 20, 1884.

IT is proposed to purify sewage by the oxygenating action of the air, alone, or mixed with other gases, such as sulphuric anhydride, oxygen, chlorine, etc. Three methods are proposed:—(1) submitting the sewage in the form of a spray to the action of the air or gases in closed spray chambers; (2) forcing the sewage into the air in the form of a jet, spray, or fountain, thus securing oxygenation and purification; (3) cascading the sewage through the air in the form of a spray from a higher to a lower level through perforated plates. By using one of these methods it is claimed that the oxygen "burns or oxygenates the impurities of the liquid under treatment."—C. C. H.

Improvements in the Purification of Water, etc. F. R. Conder, Guildford. Eng. Pat. 6459, May 27, 1885.

FOR the purpose of (1) purifying sewage or water contaminated with organic matter, or (2) for facilitating the

filtration of impure water, or (3) for the preservation of meat, the patentee proposes to use sulphate of iron either in solution or in the crystallised form. In the case of the meat, the surface is covered with a solution of the sulphate iron. Three claims are made for the applications as above described.—C. C. H.

(*C*) DISINFECTANTS, Etc.

Activity of Antiseptics. Ratimoff. Bied. Centr. **14**, 360.

Seventeen antiseptics were tested on septic and putrefactive bacteria, and on microbes. Determinations were made of the quantity of each antiseptic required to kill or sterilise, and of the quantities which were insufficient to kill or sterilise. From the results of these investigations the antiseptics are arranged in the following order of activity:—(1) Mercuric chloride, (2) silver nitrate, (3) iodine, (4) thymol, (5) copper sulphate, (6) salicylic acid, (7) zinc chloride, (8) phenol, (9) quinol, (10) kairine, (11) resorcinol, (12) chloral hydrate, (13) boric acid, (14) alcohol, (15) oil of gaultheria, (16) bitter-almond oil, (17) eucalyptus oil. The following table illustrates the mode of observation, and the action on meat broth of some antiseptics, diluted as indicated:—

Antiseptic.	Microbes.		Bacteria.			
			Putrefactive.		Septic.	
	Sterilised.	Not Sterilised.	Killed.	Not Killed.	Killed.	Not Killed.
Mercuric Chloride............	1 : 13,300	1 : 25,000	1 : 800,000	1 : 1,000,000	1 : 66,700	1 : 100,000
Thymol	1 : 2,000	1 : 5,000	1 : 25,000	1 : 50,000	—	—
Salicylic Acid	1 : 400	1 : 500	1 : 1,200	1 : 2,000	1 : 1,000	1 : 2,000
Phenol........................	1 : 400	1 : 500	1 : 570	1 : 670	—	—

—D. A. L

A Combined Disinfecting and Fumigating Compound. T. Stoner, Bradford; and J. Turton, Shipley. Eng. Pat. 4677, April 16, 1885.

Twelve parts of finely-crushed common salt are mixed with two parts of tar-oil of 0·700 specific gravity, one part of carbolic acid of 1000 specific gravity, and one quarter part of oil of eucalyptus; chemical action ensues, "the quantity of carbolic acid increases," and the colour changes from yellow to dark grey. Powdered wormwood may be added, equal to one quarter part, when the compound is not required to be wholly soluble in water.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Electrodes for Secondary Batteries. R. Tamine, Mons, Belgium. Eng. Pat. 12,824, September 26, 1884.

The author proposes to construct electrodes by heating rosin to its fusing point and adding a mixture of peroxide of lead and lead filings, then letting the mass cement together under a pressure of upwards of one hundred atmospheres.—T.

Improvements in Secondary Batteries, partly also applicable to Primary Batteries. G. G. André, Dorking. Eng. Pat. 13,752, October 17, 1884.

A battery is constructed of elements of two different lengths for convenience of connection, which consists of wooden cores soaked in paraffin and lapped round with a layer of sheet lead or wire; these are held in the cell by a removable frame in such a way that they can be bodily removed and sent to the charging station without necessitating the transport of the cell with the electrolyte contained therein.—T.

Improvements in Secondary Electric Batteries or Electric Accumulators. C. S. Bradley, Yonkers, U.S.A. Eng. Pat. 2463, February 24, 1885.

An electrolyte consisting of a nearly saturated solution of a metallic bromide is used, the metal being deposited upon one electrode, and the bromine being set free at the other electrode, and taken up by the solution when the battery is charged.—T.

Improvements in Smelting Ores by an Electric Current, and in Furnaces or Apparatus therefor. Eugene H. Cowles and Alfred H. Cowles, both of Cleveland, Cuyhoga County, State of Ohio, U.S.A. Eng. Pat. 6994, June 9, 1885.

This process consists in using granular material of high resistance, mixed with the ore to be reduced, which is placed in a retort constructed of non-conducting material embedded in a substance such as mineral wool, which is not a good conductor of heat. An electric current is made to traverse the entire length of the retort, passing at the same time through the mixed substances required to be reduced.—T.

XIX.—PAPER, PASTEBOARD, Etc.

The Art of making Paper by the Machine. J. W. Wyatt. Proc. Inst. Civil Engineers, vol. 79, 1884—1885.

1. Materials: Linen, cotton, esparto.

2. Manufacture: Cutting and dusting, boiling, reducing to pulp; (*a*) breaking, including bleaching and washing; (*b*) beating, producing a felted web by means of the paper-making machine; sizing, including animal and vegetable; glazing, finishing.

1. *Materials.*—Vegetable fibre contains 75% to 78% of cellulose, together with glutinous, resinous, siliceous and other intercellular matter which it is the object of the paper-maker to remove as far as possible. Rags, having already undergone a process of manufacture, consist of almost pure fibres, and merely require boiling with an alkaline solution at a low pressure. The substitutes, however, contain all intercellular matter in its original form. Cellulose is untouched by boiling with NaHO, unless the action is carried too far. With long and careful manipulation in the pulping-engines, taking precaution to draw the fibre and not to cut it, new cotton will give a much stronger and closer paper than new linen. The author considers that the strongest paper is made from new cotton, and one-fifth or one-sixth of its bulk of new linen. The peculiar value of esparto is the ease with which it is bleached, producing a paper of great whiteness, non-transparent, and when animal-sized, comparing most favourably with that obtained from rags. The fibres of wood are short and brittle as compared with the above-mentioned fibres, and when used alone impart their characteristics to the paper, being too short and thick to yield that suppleness so characteristic of rag-paper. The Russian supply of rags is almost entirely linen, and that of a very strong and fine quality, but coarsely spun, and low in colour.

French and Dutch rags are chiefly cotton, while the German rags are chiefly linen. New linen and cotton cuttings from Great Britain are much superior to those from abroad, being finer and purer. French cottons (used) are flimsy, and when new full of loading and starch. Esparto grass (*Stipa Tenacissima*, or *Machrochloa Tenacissima*), so called in Spain, and Alfa in Africa, is a spontaneous product of the siliceous and ferruginous soils of South and East Spain and North Africa. The cotton rags lose about 27%. 100lb. of raw esparto produces about 31lb. of paper; 100lb. of raw picked flax yield 56lb. of retted flax and only 9lb. of finished yarn, 6¾lb. of bleached yarn; and after losing about 25% in being made into paper, this gives only 5lb. of paper from 100lb. flax; 100lb. of raw picked seed cotton gins into 33·4lb. of ginned cotton. From this 29·4lb. of white cotton yarn are got, and a loss of 20% in conversion gives 23·6lb. paper per 100lb. raw cotton.

TABLE SHOWING LOSSES DURING VARIOUS OPERATIONS.

Rags.	Water Per Cent.	Sorting.	Cutting.	Boiling.	Breaking and Bleaching.
English New Pieces	3	0·5	1·0	3·0	12·5
French ,, ,, ...	3	0·5	1·2	7·3	13·2
German ,, ,, ...	3	0·5	1·2	11·8	11·6
No. 1 Cotton	3	0·9	2·0	3·0	12·1
No. 2 ,, ...	4	1·2	2·5	7·91	11·8
No. 3 ,, ...	4	1·5	3·8	11·16	13·6
No. 4 ,, ...	5	2·0	4·0	11·30	17·4
New Soft Tabs	4	0·5	1·0	3·00	8·4
Best White ,, ...	4	1·0	4·0	8·00	16·6
Grey Tabs	4	0·8	2·5	15·10	9·8
Unbleached Cotton............	4	0·8	2·0	12·28	13·4
White Moleskins..............	4	0·8	2·0	11·00	8·9
Drab ,, ...	4	1·0	2·0	13·00	10·1
Jean Cuttings	4	1·0	2·0	17·40	6·1
Green Cords	5	1·0	2·5	21·30	8·0
Old Blue Cotton	5	1·5	3·8	14·40	9·2
Shirtings	4	0·5	2·6	11·60	12·4
S.P.F.F.F. Linen..............	4	0·8	2·0	8·50	11·8
S.P.F.F. ,, ...	5	1·3	2·4	11·10	12·8
S.P.F. ,, ...	6	1·8	2·7	17·36	19·6
No. 1 Linen....................	4	0·5	2·0	6·80	7·4
No. 2 ,, ...	5	0·8	2·4	14·50	8·2
No. 3 ,, ...	6	1·0	2·7	19·15	9·8
No. 1 Russian Linen	6	1·5	2·4	18·70	10·0
No. 4 ,, ...	6	3·0	5·0	30·00	20·7
Linen Duck Clippings	4	0·5	2·0	15·40	9·0
Linen Threads	4	0·5	2·0	12·50	12·6
New Blue Linen	4	0·8	2·0	15·10	13·9
Unbleached Linen	4	0·5	2·0	19·20	16·0

Esparto.	Boiling Per Cent.	Breaking and Bleaching.	Total.	Remarks.
Spanish........................	39·21	11·00	45·92	{ 15·2lb. NaHO. 9·0lb. Bleach.
African........................	46·00	17·18	55·27	{ 20lb. NaHO. 9lb. Bleach.

Spanish grass is shorter and less handsome, but much more easily boiled with less alkali, and bleaches to a good white. The Alfa grass, which is greener and straighter, wastes more, does not come up in colour, and gives a weaker paper. Esparto, during process, has a total loss of about 48%, while all grades of linen and

2. *Manufacture.*—Rags are sorted as follows: Linen and cotton, used and unused, bleached and unbleached, old and new colours and prints, blues, etc. These classes are further subdivided for strength and cleanliness. Rags are first passed through a revolving duster in bulk, and are then cut by hand into pieces of about 14 inches

square. The inherent moisture is from 3% to 6% according to quality, but should not be more. The waste varies with the age and coarseness of the material.

Waste in preliminary dusting and sorting = 0·4% to 6%.
 „ cutting and final dusting (for fine new cottons) = 1% to 1·3%.
 „ cutting and final dusting (for coarse white cottons) = 2% to 4%.
 „ cutting and final dusting (for fine white linens) = 1·5% to 2·5%.
 „ cutting and final dusting (for coarse linens) = 2·5% to 3%.
 „ cutting and final dusting (for lower grades) = 4% higher.

Esparto, after overhauling, is passed through a thrashing-machine, and is then ready for the boiler. The boilers used are either rotary or stationary—the rotary boiler being often 10 to 25 feet long by 7 feet or more. Frequently they are spherical instead of being cylindrical, and about 8 feet in diameter. An ordinary stationary boiler will take 12 to 18cwt. of rags, and will be worked at 10lb. for from 14 to 12 hours according to material and quality. The alkaline lye used varies, some using lime, others soda, others a mixture of the two. For esparto the pressure is kept at 35 to 40lb. for best grass, the time being 3 to 4 hours. After this boil another is given with plain water for about an hour at 12 to 15lb. in order to remove all caustic solution. Of course steam pressure, amount and strength of lye, etc., varies in every mill. For overhauling after boiling, a machine has been devised similar to, and on the same principle as the paper-machine. The stuff leaves this machine containing about 50% of H_2O, and ready for the beating-engine. Before the present pulping engines were invented, rags were reduced to their original fibres by pounding under heavy hammers. It was a lengthy and cumbersome process, and soon gave way to the "Holländer." For low papers—*i.e.*, wrappers, etc.—the whole process takes place in one engine; but this will not do for higher classes, as the rolls and bars, while suitable for opening, are not suitable for reducing it to fine pulp. Engines are made to hold almost any quantity, varying from 150lb. to upwards of 1000lb. of dry paper. Before bleaching is commenced, all signs of textile nature must have been removed from the material, and afterwards all chlorine must be carefully removed from the pulp to prevent any after action. A heat of 120° to 130° F. is sufficient, and the bleach solution should stand at about 5° Tw. Grass requires 22 to 30 gallons per cwt. of paper made, cotton rags 3 to 11 gallons, and linen rags 11 to 24 gallons. Pronteaux estimates the loss in bleaching at about 1·5% to 3·5% for finer rags, and from 2·8% to 7·5% for coarser grades. The object of adding starch to sizing materials in paper is to render it denser, stiffer, and less spongy. Usually 2% to 4% or more is employed, and added either to the engine direct or else mixed with the size. Writing and printing paper can be made to carry with ease 10% to 20% of clay, and wrappers more than 25%. A considerable amount of attention requires to be given to the drying process in the paper-machine, and Hoffmann calculates about ½lb. of coal as being required for drying 1lb. of paper. The average speed of a paper-machine on fine writings is from 60 to 70 feet per minute, but on thinner weights the machine may be driven up to 120 feet per minute. A ton of good hide-clippings will produce from 2100 to 2600 gallons of size, which, when diluted to working strength, will give about 2500 to 3100 gallons, and will size from 24,000 to 48,000lb. of paper already one-third engine-sized. Generally 10lb. of alum are required per 100 gallons of size. The following recipe is given for a non-absorbent engine-size:—Dissolve 85lb. of soda-ash at 57% in 60 gallons of boiling water, and in this lye dissolve 6cwt. of ground resin. When cool remove the top layer, which is dark brown, and dilute the lower part with 12 to 13 volumes of water for use. An equivalent quantity of $Al_2(SO_4)_3$ at 7° Tw. will be required for precipitating, and these quantities will size about 20,000lb. of paper. The cost per lb. of engine-sizing is about 0·068d., and that of animal-sizing about 0·486d. All the better papers require smoothing more or less, and this may be done either in the web or in single sheets by hand. Glazing by hand costs for wages and repairs about 0·32d. per lb., calculated on 3,250,000lb. per annum, and with 17 hand-machines. An ordinary web calender will surface at about 300 feet per minute. A very high surface may be given to paper very quickly by "burnishing"—*i.e.* friction and heat. Generally one surface only of the web is so treated. A chilled roll is used on one of cotton or paper, the ration being 4 : 5 = ⅕ friction. The highest pressure in either hand or calender glazing amounts to ¾ to 1 ton per running inch across the web. The great bulk of the power required is consumed in driving pulping engines. The total horse-power for all purposes may be roughly put at 300 horse-power per 1000 tons of paper per annum for an engine-sized mill, and 380 horse-power for same amount for a tub-sized mill; 75% of this power is consumed in driving pulping engines. This paper is accompanied by two most valuable plates, with illustrations of paper-making machinery, and contains a mass of interesting and useful information for which the original should be consulted.—H. A. R.

Testing Paper. W. Herzberg. Rep. Anal. Chem. **5**, 189.

THERE is in Prussia a Government laboratory where paper is subjected to various tests. These are *mechanical tests—i.e.*, examination as to strength and resistance to tearing,—and *physico-chemical tests*, including the microscopic examination of the fibre, the sizing, determination of certain chemical constituents, of the amount of ash, etc., of different papers. Good paper boiled in water ought not to be changed, whilst a bad paper falls to pieces. The presence of size made from animal matter is determined by treating the aqueous extract of the paper with mercuric chloride, and then with caustic soda. The yellow precipitate, by subsequent heating, is reduced to a black precipitate of metallic mercury, a reaction not ensuing if vegetable sizing materials have been used. The testing as to the permanence and strength of the sizing itself ("Leimfestigkeit") is determined by means of aqueous tannin solution and ferric chloride. The amount of potato starch used for fixing the size is determined by the blue shade produced on dipping the sample in iodine solution. In papers used for certain chemical purposes, it is necessary to be acquainted with the amount of iron present. Mechanical wood pulp is tested for iron with phloroglucol solution, which colours the paper made from it a blood-red tint. Sometimes even free alkali or free acid may have to be sought for. The amount of ash in good papers may, it is stated, reach so high a figure as 1·5 per cent. (*Industrieblätter. Jahrg.* xxii. [9].)—W. S.

Improvements in the Manufacture of Paper Pulp. A. Mitscherlich, Germany. Eng. Pat. 11,816, August 30, 1884.

THE main novel points in this invention are as follows:—(1.) An improved process for mechanically purifying cellulose by guiding the pulp, greatly diluted with water, in a horizontal direction, and at a low velocity, through long and wide channels, and afterwards vertically through a large slit sieve arranged below the level of the liquid, and agitated with a slow vertically alternating motion, substantially for the purpose set forth. (2.) An improved process for drying paper pulp by means of a continuous centrifugal apparatus, in which the water is removed, while the paper pulp remaining on the inside of the screens, forming the surface of the apparatus, is discharged therefrom in consequence of the inclined position of the apparatus.—H. A. R.

Improvements in the Process of, and Apparatus for Boiling Wood with Sulphites. A. Mitscherlich, Germany. Eng. Pat. 11,655, August 26, 1884.

THE most important points in this invention are—(1.) The construction of air-tight kilns by using bricks steeped, when hot, in tar, and by cementing them with mortar containing quartz sand, sieved coal, ashes, etc., with tar. (2.) The conducting of the hot gases through a U-shaped system, cooled by the ordinary current, and, if required, by a special draught. (3.) The employment

of the various descriptions of wood for the production of sulphite cellulose of the dimensions specially laid down, and with removal of the bast, and in the case of larch and Scotch fir also of the core. (4.) The method of boiling sawdust in small heaps between larger pieces of wood. (5.) The method of preventing the spent liquors from sulphite boilings from being obnoxious, by discharging the same through iron pipes into collecting tanks containing cold liquid, and then causing the same to mix with about one thousand times their volume of water. (6.) The method of avoiding discoloration of the cellulose by keeping the temperature of the material at or below about 212° F., both before and after the reaction has taken place.—H. A. R.

Improvements in Sizing Paper. A. Mitscherlich, Germany. Eng. Pat. 12,566, September 18, 1884.

THIS invention relates to the use in the sizing of paper of materials, such as the extract obtained when fir (*Picea abies L.* or *Picea excelsa*) is subjected to a process of sulphite boiling. "By this new method of sizing certain paper materials special advantages are obtained. In sizing, for instance, the sulphite cellulose, by use of a sufficient quantity of this glue material (extract and resin soap), under otherwise equal conditions, I get, by the afterwards described proceeding, a transparent and very strong product, which, comparatively, is not too brittle, and similar to the paper parchment." If paper sized by this process be further filled with a body like linseed oil, the inventor claims an increase in strength up to 70 per cent., and nearly perfect transparency. The use of such paper is suggested for tracing purposes, for use instead of dim panes of glass, and generally for the uses to which such transparent papers are put, as are intended to give protection against atmospheric influences at a very low expense; also for the manufacture of board and papier-maché textures.—H. A. R.

Improvement in Machines for Waxing and Oiling Paper. H. Mason and W. Rawlinson, Middlesex. Eng. Pat. 547, January 14, 1885.

THE object of this invention is to equalise the deposit, and remove the superfluous wax or oil, whereby the quality of the paper is improved, and the cost of production reduced. A scraper, heated by steam, is applied to act on the under surface of the paper immediately on leaving the hot-pressing rolls through which it passes on leaving the bath. The scraper has a bevelled edge, and is heated by conduction by a steam pipe passing through a slot along the whole length of the back of the scraper. The arrangement can be adjusted by screws, and the superfluous matter removed is returned to the bath. Drawings are given, fully illustrating the apparatus.
—H. A. R.

Improved Process and Apparatus for Bleaching Waste-Papers. Wm. Clark, London. From E. A. D. Guichard, Paris. Eng. Pat. 12,385, September 13, 1884.

"WASTE printed and manuscript paper has never hitherto been bleached sufficiently to make it suitable for forming a pulp for the manufacture of white paper." This invention relates to the treatment of such paper mechanically in presence of a bleaching liquid. The machine is illustrated in the accompanying drawing, Fig. 1 being a longitudinal section, and Fig. 2 a transverse section of one arrangement. Fig. 3 shows the interior surface of the drum in the flat, and Fig. 4 is a section taken through the walls of the drum to show the studs fixed therein. A wood drum *a* of suitable dimensions is provided with an opening, at which paper and bleaching liquor is introduced and closed by a wood cover *b*, faced with india-rubber, so as to make a water-tight joint. The interior of the drum is studded with bosses, as shown in Fig. 3. It is also provided with end journals *c*, on which it is mounted in frame *d*, and with a cock *h* for running off the spent liquor. After being cut up, the materials are placed in the cylinder with a quantity of pebbles, and a number of balls of cast-iron or stone, etc. When the drum is revolved the balls and pebbles reduce the paper to pulp, and by means of the bosses the balls and pebbles are projected in all directions. After adding the bleaching liquid required, the drum is revolved until the liquid is almost black, and the operation then repeated if required. Subsequently the pulp is treated in the hydro-extractor to produce cakes of half-stuff with 40—50% of water. The following mixture is recommended for a bleaching liquid :—

Spirits of turpentine	2 parts.
Bleaching liquor	9 ,,
Soap-suds	9 ,,

FIG. 1.

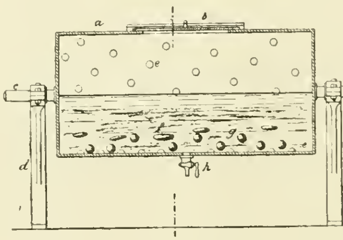


FIG. 2.

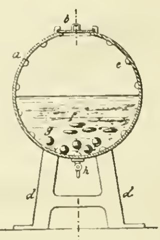


FIG. 3.

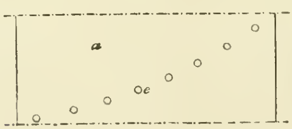
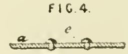


FIG. 4.



The machine may be modified as shown in the sectional elevation in Fig. 5, in which the same letters of reference indicate the same parts as in the previous figures. The improvement consists in fixing a grating or wire cover *j* over the discharge orifice *k*, which is placed at one end of the drum so as to allow of none but clear liquid to pass and to prevent the outlet being choked. The grating *k* is prevented from being clogged by pulp by pressing against a brush *l*, extending its whole length, and fixed upon the rod *m*, one end of which is supported in the

FIG. 5.

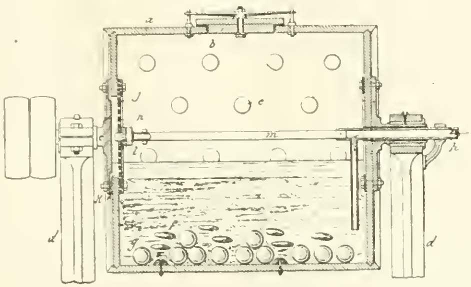
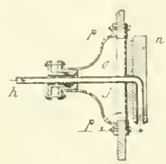


FIG. 6.



hollow inlet pipe *h*, at which the bleaching liquid is introduced, the other end being fitted centrally in the grating *j*. In Fig. 6 the rod *m* is dispensed with, and the inlet and outlet for the liquid is at the same end of the drum. For this purpose the inlet pipe *h* is carried through the back *n* of the brush, and is wholly enclosed thereby, so as to be protected from injury by the pebbles and balls. After passing through the grating *j*, the liquid is received in chamber *o*, bolted to the drum, and escapes through openings *p*.—H. A. R.

Improved Apparatus and Process for obtaining Cellulose and Glucose from Wood. Adolph Behr, Cöthen, Germany. Eng. Pat. 1767, February 9, 1885.

THIS specification relates to improvements in apparatus described in inventor's patent of July 5, 1884, No. 9797. As novel are claimed the arrangement or combination of several extraction cylinders and their connections with each other, also the construction of the extraction cylinder itself with heating chamber, perforated plates, coolers and stand-pipes.—H. A. R.

Improvements in Softening Vegetable Parchment. H. H. Leigh, Middlesex. From C. Eichhorn, of Jülich; and T. Mohr, of Stozheim, Germany. Eng. Pat. 5610, May 6, 1885.

INVENTOR claims to be able to render vegetable parchment supple and soft, and more suitable for covering jars and bottles, as well as for other purposes, for which it would be totally unfit as long as it retained its characteristic crispness and non-elasticity. The substance used to effect the said change is applied in the form of a bath, and is made as follows:—

Glycerol ... . 6 parts by weight.
Calcium chloride ....4 ,, ,,
Add water until sp. gr. = 18°—20° B.

The sheets of parchment, as they come from the maker, are to be immersed in this bath, for a time varying with the thickness of the sheets and the degree of softness required.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Quantitative Determination of Cinchonidine in Commercial Sulphate of Quinine. De Vrij. Arch. d. Pharm. 11, 452.

FIVE grm. of the preparation are dissolved in 11cc. of normal sulphuric acid, by warming to about 60° C. The solution is evaporated in a weighed dish till a pellicle forms, and allowed to crystallise. A quantity of distilled water is then added, sufficient to make up the original weight, and the solution which contains the cinchonidine as acid sulphate is shaken with excess of soda and 25grm. of ether. The latter brings the separated cinchonidine in crystals to the surface of the liquid, where they can be collected and weighed. By this method a mixture of 2 per cent. of cinchonidine with quinine sulphate can be detected.—E. G. C.

Improvements in the Manufacture of Salicylic Acid, and of the Homologues thereof. J. Y. Johnson, London. From Dr. F. von Heyden, Dresden. Eng. Pat. 10,167, July 15, 1884.

THE object of this invention is to produce one molecule of salicylic acid from one molecule of sodium phenylate without the re-formation of phenol as in the ordinary way. Three methods are described. (1.) Dry CO_2 at the ordinary temperature is passed over dry sodium phenylate; phenyl sodium carbonate is formed. This is heated in a digester to from 120° to 140° C. The salicylic salt is formed by molecular transformation, is then dissolved in water and the acid precipitated by means of a mineral acid, and then recrystallised. (2.) Dry alkaline phenylates are placed in a closed vessel into which dry CO_2 is forced by a

pump or else by the evolution of gas from liquid CO_2. If the vessel be kept cool during the process no phenol separates. The phenyl carbonic salt is transformed by heat as before. (3.) The reaction described in (2) is effected by the introduction of solid CO_2, and proceeding as before. The patentee claims the production of phenyl carbonic alkaline salts, etc., and the substitution salts and homologues as above described.—C. C. H.

Improvements in Anæsthetics. From Robert Jackson Hunter, of Boston, U.S.A.. Eng. Pat. 7343, June 16, 1885.

THIS invention relates to the production of an anæsthetic by mixing nitrous oxide gas with the vapour of alcoholic tinctures of various sedative, anti-spasmodic or diaphoretic substances, such as hops, stramonium, or valerian. —T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Two New Indicators for use in the Volumetric Determination of Caustic Alkalis in the presence of Carbonates. R. Engel and J. Ville. Compt. Rend. **100**, 1074.

THESE are sulphindigotic acid and Poirrier's soluble blue (c 4 B.), which are not affected by carbonates, but are altered in colour by caustic alkalis, the first-named being changed to yellow and the second to red. The sulphindigotic acid is prepared by neutralising a solution of indigo in fuming sulphuric acid with calcium carbonate, adding ten times the volume of water, and filtering. —E. G. C.

Separation of Copper and Cadmium. A. Béhal. Journ. Pharm. Chim. 5 Ser. 11, 553.

A STRONGLY alkaline solution of sodium tartrate produces no precipitate in a solution containing a mixture of copper and cadmium salts. On boiling the solution, all the cadmium is thrown down as oxide, the copper remaining in solution. Ammonium salts must be destroyed by boiling with a slight excess of alkali. —E. G. C.

New Method for the Determination of Phosphoric Acid by Precipitation with Molybdenum. Meineke. Rep. Anal. Chem. **5**, 153.

THE yellow precipitate, produced by the action of ammonium molybdate on phosphoric acid, loses water and ammonia when heated from 400—500° C., and becomes partially converted into molybdic-molybdenum oxide, a compound which is very stable, only slightly hygroscopic, and admits of accurate weighing. The author finds that it contains 4·018 per cent. P_2O_5, 65·195 per cent. Mo, and 30·787 per cent. O, corresponding to the formula $P_2O_5.4(Mo_6O_{17})$. The solution of the phosphate, acidulated with nitric acid, and containing about 20—25 per cent. of ammonium nitrate, is precipitated at 50—60° C. and allowed to stand without further warming for some hours. The precipitate is collected on a filter and washed with a 20 per cent. solution of ammonium nitrate (slightly acidified with nitric acid) until ten drops give no precipitate with sulphuretted hydrogen, and then with water, or with smaller quantities of water, alcohol and ether. The precipitate and filter paper are as far as possible separated, and ignited separately, the filter paper at as low a temperature as possible. The ashes are then added to the precipitate, and the temperature is raised, so as to be sufficient to cause a slow decomposition of the precipitate, which gradually blackens. When the decomposition is complete, the precipitate, which contains 4·018 per cent. of P_2O_5, is allowed to cool, and weighed. The results are accurate. —E. G. C.

On Sources of Error in the Determination of Phosphoric Acid. J. König. Rep. Anal. Chem. **4**, 161.

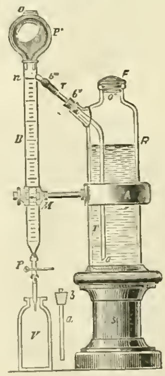
IN numerous cases annoying discrepancies between duplicate determinations of phosphoric acid by different chemists can be traced to incorrect sampling, but the author points out that in a great number of cases these differences are due to the unequal purity of the reagents used. For instance, he has met with molybdic acid, which, employed in the usual manner for the preparation of the molybdic solution, yielded, by reason of its greater impurity, results several percentages too low, as compared with a solution made from pure molybdic acid. Great care is necessary in preparing molybdic acid from molybdic residues in the laboratory. Samples of molybdic acid from three different firms were tested qualitatively for chlorine, nitric acid, and ammonia, and the loss on gentle ignition was determined quantitatively, from which it is obvious that differences in composition between different samples of molybdic acid, or of ammonium molybdate may, in consequence of the variations in strength of molybdic solutions prepared from them, have a serious effect upon the quantitative phosphoric acid estimations, and the author advises analysts to habitually use the preparations from one and the same firm —E. G. C.

On the Examination of Citric Acid for Tartaric Acid. Ph. Pusch. (Arch. d. Pharm. 22, 316). Rep. Anal. Chem. **4**, 176.

ONE gramme of powdered citric acid is put in a test-tube, together with 10grm. of concentrated colourless sulphuric acid. The test-tube is held in a clamp, and suspended in a beaker filled with water, which is now kept at the boiling temperature for an hour. The solution changes to a lemon-yellow liquid, and a considerable disengagement of gas takes place. If the yellow colour of the solution does not alter within an hour, the citric acid was pure; but in the event of its having contained only half per cent. of tartaric acid, the tint of the fluid changes altogether, becoming brown after 30 or 40 minutes, and red-brown after an hour's standing. It is obvious that the crystals of citric acid employed must not contain pieces of wood, paper, etc.—E. G. C.

Improved Burettes. Ducretet. Rep. Anal. Chem. **5**, 185.

A CONVENIENT arrangement for use in laboratories of sugar mills, distilleries, etc., is represented in the cut. The advantage consists in the adjusting of the zero



point without pouring in or out, and without loss; also in the rapidity with which tests can be made, and the complete protection of the contents from the air. R is the reservoir for the standard solution, S a heavy sup-

port, B the burette divided into ⅕cc., A a holder for the same, P a pinch-cock, P[1] an indiarubber ball with an opening o, T junction between B and R, F glass-stopper of the reservoir with the opening O^2, V mixing vessel with the rod *a*. R is filled with solution through F, and the air removed from P[1] by compression and o closed. The liquid is thereby drawn up from R to B, and the zero is each time adjusted by the flow through T. The vessel V is more convenient than a flat one, and the rod *a* is for taking samples.—H. A. R.

Volumetric Estimation of Carbon Bisulphide in Sulphocarbonates. Falières. Rep. Anal. Chem. **4**, 219.

TEN grammes of the sulphocarbonate (which can be measured off after the specific gravity has been determined) are mixed, in a granulated cylinder capable of holding 50cc., with 9 to 10cc. of benzene and about 10cc. of water. 20cc. of sodium bisulphite, sp. gr. 1·32, are then added after the mixture has been well shaken. The sodium bisulphite decomposes the sulphocarbonate, and the carbon disulphide formed dissolves in the benzene. The decomposition is complete in about an hour. From 8 to 10cc. of ammonia are now added, and the mixture is shaken and allowed to stand for a little while. The quantity of carbon disulphide present in the sulphocarbonate is calculated from the increase in the volume of the benzene. Tables are given, showing (1) the volumes of sulphocarbonates of different specific gravities, corresponding to the weight 10grm., and (2) the percentages of carbon disulphide corresponding to different increments in volume of the benzene.

—E. G. C.

Detection of Nitric Acid in the Presence of other Acids which conceal its Reactions. Antonio Longi. Rep. Anal. Chem. **4**, 220.

IF acid, the solution is neutralised with sodium carbonate, and then treated with excess of sulphurous acid. The solution is next gently warmed, and sodium carbonate is gradually added till the solution is slightly alkaline. On boiling, chromium and other heavy metals are separated. The filtered solution is acidified with acetic acid, and again filtered if necessary. Pure peroxide of lead and more acetic acid are now added until the vapours given off cease to colour starch paper. The solution is allowed to cool, filtered, and treated with sodium sulphate, which precipitates the dissolved lead. The filtrate is evaporated to dryness on the water-bath, taken up with water, and tested for nitric acid in the usual manner.—E. G. C.

On the Employment of Hydrogen Peroxide in Chemical Analysis. C. Hanowsky. Rep. Anal. Chem. 14, 220.

THE author has studied the action of hydrogen peroxide on compounds of iron, manganese and chromium, and he states that the oxidation of ferrous into ferric oxide can advantageously be effected, in weak solutions of ferrous salts, by boiling with hydrogen peroxide. Manganese is completely separated from neutral solutions of its salts by boiling them with excess of hydrogen peroxide, rendered alkaline by ammonia or potash. The precipitate is washed with hot water (to which a little ammonium nitrate has been added), dried, ignited, and weighed as Mn_3O_4. Hydrogen peroxide in alkaline solution behaves in an analogous way with solutions of chromium salts, the whole of the chromic oxide present being oxidised into chromic acid, which can be estimated either gravimetrically or volumetrically.

—E. G. C.

Report of a Commission to inquire into Uniform Methods for the Analysis of Wine. Rep. Anal. Chem. **4**, 227.

AFTER some preliminary instructions relative to the collection, etc., of samples, the following directions are given respecting the processes to be employed in the analysis. *Specific gravity*:—This is to be determined at a temperature of 15° C., by the aid of the pyknometer, or with a Westphal's balance controlled by means of the pyknometer. *Alcohol*:—For this determination the distillation-method is to be employed, and for the calculation, Hehner's or Baumhauer's tables may be used. *Extract*:—50cc. of the wine, measured at 15° C., are to be evaporated on the water-bath, in a platinum dish (of diameter, 85mm.; height, 20mm.; capacity, 75cc.; and weight, about 20grm.), and the residue dried for 2½ hours. In the case of wines containing more than 0·5 per cent. of sugar, a smaller quantity must be taken, so that the extract shall not weigh more than 1·0—1·5grm. *Glycerol*:—To determine this constituent, 100cc. of the wine are evaporated down to about 10cc., in a spacious porcelain dish; some sand and milk of lime are then added till the reaction is strongly alkaline, and the mixture is evaporated almost to dryness. The residue is next treated with 50cc. of fifty-six per cent. alcohol, warmed and stirred on the water-bath, the solution being then passed through a filter. The insoluble matter is washed with successive small quantities of hot alcohol (fifty-six per cent.), of which 50 to 150cc. will, as a rule, suffice, so that the entire filtrate will be from 100cc. to 200cc. The alcoholic extract is now evaporated to a viscous consistency, and the residue taken up with 10cc. of absolute alcohol; this solution is mixed with 15cc. of ether in a stoppered flask, and the mixture allowed to stand until clear. The clear fluid is decanted or filtered into a light tared glass vessel, carefully evaporated, and the residue dried for one hour in the water-bath. It is then cooled and weighed. In the case of sweet wines (containing more than five per cent. of sugar), only 50cc. of the wine are taken for the estimation of glycerol; sand and lime are added, and the mixture is warmed on the water-bath. After cooling, it is treated with 100cc. of ninety-six per cent. alcohol, the precipitate formed allowed to settle, the solution filtered, the insoluble matter washed with spirit, and the alcoholic filtrate treated as above described. *Free acids* (total acid-reacting constituents of the wine):—Estimated in 10—20cc. of the wine by means of one-third- or one-tenth-normal alkali. Any considerable quantity of carbonic acid to be first removed by shaking. The "free acids" to be calculated into and given as tartaric acid ($C_4H_6O_6$). *Volatile acids*:—Determined by steam-distillation, and calculated as acetic acid ($C_2H_4O_2$). The quantity of *non-volatile acids* calculated as tartaric acid is found by subtracting the equivalent of the acetic acid in tartaric acid from the *free acids* previously determined. *Potassium bitartrate and free tartaric acid*:—a. *Qualitative test for free tartaric acid*:—Some finely-powdered cream of tartar is added to 20—30cc. of the wine, and after the lapse of an hour, the mixture is shaken repeatedly, and filtered. Two or three drops of a twenty per cent. solution of potassium acetate are now added to the clear solution, which is left to stand for twelve hours. (The shaking and standing at rest must take place at as equal temperatures as possible.) Should any considerable precipitate be produced during this time, free tartaric acid is *present*, and its quantitative estimation is necessary. b. *Quantitative estimation of the potassium bitartrate and of the free tartaric acid*:—Two measured quantities of the wine (20cc. each) are put into two stoppered flasks, and mixed with 200cc. of ether-alcohol (in equal volumes). To one flask are added two drops of a twenty per cent. solution of potassium acetate (corresponding to about 0·2grm. of tartaric acid). The mixtures are both well shaken, and allowed to stand 16—18 hours at a temperature between 0° and 10° C. The precipitates are filtered off, washed with ether-alcohol, and titrated. The solution of potassium acetate must be neutral or acid, and it must not be added in too great an excess. In some cases, this method may be controlled by that of Nessler and Barth. *Malic, succinic, and citric acids*:—"Methods for the separation and quantitative estimation of these acids cannot at present be recommended." *Salicylic acid*:—To detect this acid, 100cc. of the wine are shaken repeatedly with chloroform, the latter is evaporated, and the aqueous solution of the residue tested with very dilute ferric chloride solution. For the purpose of an approximate quantitative estimation it is sufficient, on the evaporation of the chloroform, to once recrystallise

the residue from chloroform, and weigh it. *Tannin:*—Should a quantitative determination of the tannin appear necessary, Neubauer's method is to be employed. As a rule, however, the following mode of procedure will suffice: the free acids in 10cc. of the wine are neutralised with standard alkali, after which 1cc. of a forty per cent. solution of sodium acetate is added, and finally a ten per cent. solution of ferric chloride, drop by drop, and avoiding excess. One drop of this solution suffices for the precipitation of every 0·05 per cent. of tannin. *Colouring matter:*—Red wines must always be tested for aniline colours; for their detection 100cc. of wine are to be shaken with ether before and after supersaturation with ammonia. The ethereal solutions are separately tested. *Sugar:*—This is determined, after the addition of sodium carbonate, by Fehling's method, and, in wines rich in sugar, with due regard to the modifications introduced by Soxhlet and Allihn; it is calculated as grape-sugar. Highly-coloured wines are to be decolourised by the aid of animal-charcoal or acetate of lead—the latter to be used if the wine be rich in sugar, and then treated with sodium carbonate. Should the polarisation indicate the presence of cane-sugar, the sugar must be determined after inversion of the solution by heating with hydrochloric acid. The cane-sugar is calculated from the difference. *Polarisation:*—For this purpose only large and accurate instruments are to be employed. *Gum (Arabic):*—To ascertain the presence of any added gum, 4cc. of wine are treated with 10cc. of ninety-six per cent. alcohol. In the presence of gum the mixture becomes milky, and only becomes clear again after many hours. The precipitate formed clings to the sides of the vessel in firm masses. In pure wines, a loose flocculent precipitate is formed after a short time, and very soon settles down. To determine the gum accurately, the wine is evaporated to a syrup, treated with ninety-six per cent. alcohol, the insoluble matter separated, redissolved in water, and heated for two hours under pressure with hydrochloric acid (sp. gr. 1·10). The reducing power of this solution is now determined with Fehling's solution, and calculated into dextrose. With pure wine there is no material reduction. Dextrine would also be detected by this method. *Mannite:*—If present, this substance is seen in the form of elongated crystals in the extract and glycerine. *Nitrogen:*—To be determined by the soda-lime process. *Ash:*—For this determination 50cc. of the wine should be taken. *Chlorine:*—The wine is supersaturated with sodium carbonate, evaporated, the residue gently ignited and extracted with water. The chlorine is determined in the solution either volumetrically (according to Volhard), or gravimetrically. *Sulphuric acid:*—Estimated directly in the wine by barium chloride, but only when the qualitative test has shown the presence of an abnormal amount. *Phosphoric acid:*—Determined in the nitric acid solution of the ash, by the molybdic method. *Sulphurous acid:*—100cc. of wine are distilled in a stream of carbonic anhydride, after the addition of phosphoric acid; 5cc. of normal iodine solution are used to receive the distillate. When the first third has distilled over, the distillate, which must still contain excess of free iodine, is acidified with HCl, warmed, and precipitated with barium chloride. *Sophistication of Grape Wine with wine prepared from other fruits:*—The detection of this form of adulteration can, with our present experience, only occasionally be effected with certainty. Specific tests are particularly unreliable; and the conclusion, based upon the absence of potassium bitartrate, or its presence in very small quantities, that a given sample of wine is not the produce of the grape, may not necessarily be a correct one. Among the substances used by manufacturers of adulterated and spurious wines are: Spirit of wine, cane or beet sugar, honey, glycerine, cream of tartar, tartaric acid, other vegetable acids and substances containing them, salicylic acid, mineral matters, gum arabic, tannic acid and materials containing it (kino, catechu, etc.), and foreign colouring matters, together with various ethers and aromatic substances. Tamarinds, dates, and figs are also employed, with the object of increasing the proportions of free acidity, sugar, and extractive matter. In an analysis of wine, the following determinations are, as a rule, necessary:—Extract, alcohol, glycerine, sugar, free acids (total), free tartaric acid (qualitative), sulphuric acid, total mineral substances, gum, polarisation, and (in red wines) foreign colouring matters. In particular cases determinations must also be made of specific gravity, volatile acids, potassium bitartrate, and free tartaric acid, succinic, malic, and citric acids, salicylic acid, sulphurous acid, tannic acid, mannite, total nitrogen, and separate constituents of the ash. Wines derived solely from pure grape-juice rarely contain less than 1·5grm. of extractive matter in 100cc.; after subtracting fixed acids, the proportion of extract remaining should be at least 1·1grm. in 100cc.; and after subtraction of free acids the residue should not be less than 1·0grm. in 100cc. The ratio of mineral matter to extract is about 1 : 10. Free tartaric acid should not amount to more than one-sixth of the total fixed acids. The proportion of alcohol to glycerine, in natural wines, ranges between 100 : 7 and 100 : 14.—E. G. C.

Remarks on the Use of Beckurt's Method for the Detection of Arsenic in Cases of Poisoning. G. Baumert. Chem. Zeit. **9**, 904.

Beckurt lately published some investigations on the detection of arsenic and the preparation of hydrochloric acid free from arsenic. The author examined Beckurt's method, and finds it very convenient. To free hydrochloric acid from arsenic, 1kilo. of pure concentrated commercial acid was treated with 10cc. of a saturated ferrous chloride solution (made by dissolving iron wire in hydrochloric acid), and a small piece of iron wire, and distilled in such a manner that the first 30% of the distillate, and the residue amounting to 10% of the whole, were rejected, whereas the 60% lying between these limits were collected. The latter proved to be absolutely free from arsenic. The same method can be employed to separate arsenic, in cases of poisoning, from various objects, such as internal organs, vomited residues, food, etc. After cutting them up to very small bits, they are stirred up to a thin paste with measured quantities of hydrochloric acid freed from arsenic, treated with 25cc. of a 4% solution of ferrous chloride and distilled. The distillation proceeds very quietly on a gas-stove, and if one-third of the acid used be distilled over, it will contain all arsenic present. The heat must be so regulated that 100cc. of the distillate are produced in 35 to 40 minutes. The apparatus consists of a tubulated retort, of ample size, whose neck is raised and connected in an obtuse angle with a Liebig's condenser. If the object of examination be very liquid, it must at first be evaporated with hydrochloric acid, if necessary, after neutralising with sodium carbonate, and afterwards distilled, as mentioned above. It makes no difference in the method of proceeding, whether arsenic is present as element, trioxide, pentoxide, or sulphide. The hydrochloric acid distillate can at once be subjected to the treatment in the Marsh's apparatus, but the liquid must be previously diluted, and a very strong evolution of hydrogen should be avoided. The gas is dried by passing through tubes filled with calcium chloride and potasssium hydrate respectively. In every case, a blank experiment with the reagents to be used, must be previously made.—S. H.

New Method for the Separation of Strychnine and several other Alkaloids in cases of Poisoning. Th. Chandelon-Zeit. f. Physiol. Chem. **9**, 46-48.

The finely-divided viscera mixed with an equal weight of anhydrous gypsum are dried at 70°, and then warmed with tartaric acid and 90 per cent. alcohol. The residue of the alcoholic extract is taken up with a little warm water, neutralised with soda, mixed with gypsum, dried in a desiccator, and extracted with chloroform. The chloroform extract is treated with an equal volume of a saturated solution of oxalic acid in ether, the oxalates of strychnine, brucine, narceine, codeine, nicotine, coniine, aconitine, hyoscyamine, veratrine, papaverine, and thebaine are precipitated after some time; completely in 24 hours. The oxalate of strychnine is washed with ether and chloroform, dissolved in water and precipitated

by ammonia. In quantitative estimations, one adds to the weight of the precipitated strychnine the weight of that dissolved in the solution (according to the author, 1 part in 6667). With the other alkaloids the oxalate is dissolved in alcohol, the oxalic acid removed with alcoholic potash, the potash by passing carbonic acid through the mixture, and the pure alkaloid is then obtained by evaporation of the alcoholic solution.—S. R.

New Books.

PHYSICO-CHEMICAL CONSTANTS, MELTING AND BOILING POINT TABLES. By THOMAS CARNELLEY, D.Sc., B.Sc., F.C.S., Professor of Chemistry in University College, Dundee. Vol. I. London: Published by Harrison & Sons, 59, Pall Mall, 1885.

QUARTO Volume, bound in black cloth, containing preface, table of contents, explanatory notes, list of abbreviations alphabetically arranged, catalogue of reference literature (with abbreviations) also alphabetically arranged, and subject matter in the shape of the tabulated constants, etc., extending over 352 pages; price £2 2s. This important work the author has very appropriately dedicated to his old teacher, Sir Henry Enfield Roscoe, LL.D., F.R.S. The tables are arranged in vertically divided columns, headed as follows:—Name (of Substance); Remarks; Formula; Boiling Point; Melting Point; Authority; Reference; *Watts. Dict.* and *Journ. Chem. Soc.* The table of contents includes the following, and thus the compass of the first volume of this work will appear:—Part I.—Elements and Inorganic Compounds. I. Elements. II. Compounds containing *two* Elements. III. Compounds containing *three* Elements. IV. Compounds containing *four* Elements. V. Compounds containing *five* Elements. VI. Metallic Alloys:—*a.* Alloys of *two* metals; *b.* Alloys of *three* metals; *c.* Alloys of *four* metals. VII. Alloys of Inorganic Compounds: *a.* Alloys of *two* compounds; *b.* Alloys of *three* compounds. Part II.—Organic Compounds. I. Compounds containing *two* Elements. II. Compounds containing *three* Elements. The "Apology for writing this book" by the author, it is only fair to state. Those who imagine the work to be one of essential value for reference for chemical formulæ, melting- and boiling-points are entirely correct, but it serves another equally valuable purpose, for the research-chemist perhaps a still more valuable one—viz., to take the place of a class of works possibly better known in Germany than in this country, as a "*General-Register*," for ready and rapid reference to the original sources in the whole of the literature of chemical experience or research. In the preface Dr. Carnelley writes:—"My object in preparing the tables has been—*First:* To present as complete a list as possible of *all* known melting- and boiling-point data, and at the same time to indicate which of them is probably the most exact when there are several determinations referring to the same substance. *Second:* To state as fully as possible the constitution of each substance to which the data refer. *Third:* To adopt such a system of arrangement as would facilitate, as far as possible, the ready finding of the data relating to any given substance. *Fourth:* To give the authority and reference to the original memoir in each case. *The tables thus form a catalogue also of the literature referring to most chemical substances. Fifth:* As but comparatively few chemists have sufficiently large libraries of their own, or can conveniently refer to the original papers in all cases, I have thought it desirable to give in addition the reference (if any) to either *Watts' 'Dictionary of Chemistry,'* or to the '*Journal of the Chemical Society of London,*' or both. This is a feature of the work which I believe will be found particularly useful, more especially to British and American investigators."

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

9818 J. Hill, Glasgow. Improvements in and connected with gas-producers, and regenerators or furnaces, and their construction and arrangement and fittings as applied to steam boilers for the generation of steam. August 19

9930 W. Hutchinson, London. Improvements in refrigerating apparatus. August 21

10083 J. Storer, Glasgow. Improvements in constructing furnaces, converters, flues, and other apparatus in which great heat is employed. August 26

10112 A. Reis, London. An apparatus for producing a draught in boiler and other furnaces, and for purifying the products of combustion. August 26

10143 J. A. Drake and R. Muirhead, London. Improvements in and connected with filter presses. August 27

10166 J. Johnston, Manchester. Improvements in apparatus for heating, drying, and other purposes. August 27

10169 B. H. Remmers and J. Williamson, Glasgow. Improvements for facilitating the removal of cakes or sludge from filter presses. August 27

10258 A. Dempster, Elland. An improved fastening for retort lids, furnace doors, covers, and the like. August 29

10355 E. Edwards, London—Communicated by G. Lunge, Switzerland, and L. Rohrmann, Germany. Improvements in apparatus for effecting the absorption of gases by liquids or solids. September 1

10570 B. H. Remmers and J. Williamson, Glasgow. Improvements in filter presses. September 7

10618 J. Binks Cooper, Whitehaven. Improvements in stationary boiler flues for economising fuel and consumption of smoke. September 9

10657 F. Bernard Dœring, London. Improvements in apparatus for evaporating sea-water, nitrate, or other solutions or liquids. September 9

10663 E. Edwards, London—Communicated by E. Fourcault and E. Jacques, Belgium. Improvements in regenerative hot-air furnaces. September 9

II.—FUEL, GAS, AND LIGHT.

9773 H. J. Allison, London—Communicated by C. Carroll Yeaton, United States. Improvement in process of generating hydrogen gas. Complete specification. August 18

9797 H. Ffrench Bromhead, London. Improved device or apparatus for purifying gas. August 18

9876 J. Murrie, Glasgow. An improved method of generating vapour. August 20

10139 J. Kingsford Field, London. Improvements in treating hydrocarbon bodies or substances. August 27

10234 L. Chandor. A tischolin candle. Complete specification. August 29

10301 J. H. Selwyn, London. Improvements in liquid fuel furnaces and their appliances. August 31

10535 H. J. Haddan, London—Communicated by W. St. Martin, Belgium. Means or apparatus for obtaining an inflammable gas mixture from mineral oil and water or steam, and for utilising the said mixture for the production of heat and light. September 5

10666 C. W. Bradshaw, Tottenham; and J. Carpenter, Hammersmith. Apparatus for generating gas for illuminating and other purposes from mineral and other oils. September 9

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

10438 H. J. Haddan, London—Communicated by J. Quaglio, Germany. Apparatus for compressing coal and introducing the same into coke-ovens. September 3

IV.—COLOURING MATTERS AND DYES.

9858 J. H. Johnson, London—Communicated by The Badische Anilin- und Soda-Fabrik, Germany. Improvements in the manufacture of yellow and orange colouring matters suitable for dyeing and printing from dioxytartaric (carboxytartronic) acid. August 19

10377 W. Clark, London—Communicated by the Fabrik vorm. Bronner, through Wirth & Co., Germany. Improvements in the production of colouring matters. September 1

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

9811 M. Raabe, A. C. G. Skynner, and S. Henning, London. A new manufacture of yarns and woven and felted goods from animal and vegetable fibres, the said vegetable fibres being treated so as to give them qualities and characteristics of animal fibres, and being applicable also for use alone in the manufacture of yarns and woven and felted goods. August 18

9931 J. V. Eves, London. Improvements in machinery for the preparation of flax, tow, and other fibrous substances. August 21

10046 H. J. Haddan, London—Communicated by Pelzer et Fils, Belgium. Improvements in the treatment of textile materials with liquids and gases, and in apparatus therefor. August 25

10265 J. C. Mewburn, London—Communicated by F. Lorthiois, France. Improvements in and apparatus for desiccating wool to facilitate the removal of vegetable substances therefrom. August 29

10508 R. Wild and H. Ledger, Leek. Improvements in the means and apparatus for breaking, opening, separating, combing, and cleaning and carding of fibrous materials. September 5

10509 R. Wild and H. Ledger, Leek. Improvements in the mode and apparatus for the breaking and opening up and cleaning, washing, bleaching, and drying of fibrous materials. September 5

10554 W. H. Slade, London. An improved waterproof cloth. Complete specification. September 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

10723 C. J. Cox, London—Communicated by Aug. Jeannolle, France. An improved method of dyeing black upon cotton, silk, or wool, or a combination in raw, bank, or manufactured fabric, producing thereby a solid, clean, and permanent black. September 10

VII.—ACIDS, ALKALIS, AND SALTS.

9831 W. Weldon, Burstow—Communicated by A. R. Pechiney et Cie., France. Improvements in mode of procedure for decomposing by magnesia the mother-liquor of the ammonia-soda process. August 19

9853 T. H. Cobley, Dunstable. Improvements in the manufacture of carbon alum, and application of the same to useful purposes. August 19

10080 E. W. Parnell and J. Simpson, Liverpool. Improvements in obtaining sulphur from sulphuretted hydrogen. August 26

10598 A. E. Robinson, Edgbaston. Improvements in the preservation from oxidation of certain salts of iron. September 8

10661 A. Pillans Laurie, Glasgow. Improvements in the preparation of crystal soda and caustic soda from tank liquor. September 9

10700 J. J. Hood, London. Improvements in the manufacture of ammonic bichromate. September 9

VIII.—GLASS, POTTERY, AND EARTHENWARE.

10378 G. Jones Atkins, London. A new or improved furnace for burning or firing stained or painted glass and enamels, and for other purposes. September 1

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

9780 W. P. Thompson, Liverpool—Communicated by G. Lilienthal, Melbourne. Improvements in the manufacture of artificial stone. August 18

10362 G. Butchard, London. Improvements in the manufacture of cement, and apparatus therefor. September 1

10445 G. Bird, London. Improvements in paving bricks. September 3

10454 W. R. Lake, London—Communicated by F. J. Grenier, France. Improvements relating to cement and similar materials, and to the utilisation of the same for paving and other purposes. September 3

10480 W. G. Margetts, London. Improvements in the method of loading or charging cement kilns. September 4

10492 W. Clark, London—Communicated by E. E. Fagnet, France. The manufacture of a composition suitable for making wall coverings and other fabrics, moulded articles and other uses. September 4

10544 M. Beaumont Parrington, London. Improvements in kilns and other structures employed in the manufacture of lime and cement. September 5

10585 G. Butchard, London. Improvements in kilns. September 7

10740 G. Butchard, London. Improvements in kilns for burning cement. September 10

X.—METALLURGY, MINING, Etc.

9781 W. P. Thompson, Liverpool—Communicated by E. H. Cowles and A. H. Cowles, United States. A new or improved process for obtaining aluminium and other metals from their ores, alone, or as alloys with copper or other metals. Complete specification. August 18

9809 W. R. Walton, London. Improvements in the process of preparing copper for casting. August 18

9841 D. H. Haggie and G. A. Haggie, London. Improvements in the manufacture of ropes of metal. August 19

9883 G. Leyshon, London. A new or improved method of and apparatus for manufacturing tin and terne plates or sheets, and for galvanising sheets of iron. August 20

9887 S. H. Emmens, London. Improvements in the chemical treatment of certain aluminous minerals, and in the utilisation of the industrial products thereby obtained. August 20

9894 J. Gilling Williams, London. An improved process for making purple ores or other fine ores into bricks or blocks of required "shape." August 20

9993 H. Grimshaw, Manchester. A new or improved process for treating galvanised iron or steel. August 24

10018 H. H. Lake, London—Communicated by the Verein Chemischer Fabriken, Germany. Improvements relating to the separation of tin from tin-plate, and to the production of protochloride of tin. August 24

10024 R. Oxland and C. Oxland, London. Improvements in the treatment of ores and materials containing sulphur for the extraction of metals and other constituents. August 24

10055 R. Bonehill and L. Hagué-Halon, Liverpool. A blast-furnace for the treatment of all kind of ores. August 25

10085 C. Berry Phillips and G. Bargate, Chester. Smelting of complex ores, such as the Anglesea and Wicklow bluestone or similar ores. August 26

10119 S. H. Stephens and S. Rodda, London. Improvements in machinery for the reduction of tin stuff and other partially pulverised ores, to extract the metal therefrom, as well as for grinding paint, cement, and other hard substances. August 26

10154 W. H. Duncan, Coalbrookdale. Improvements in extracting, washing, and delivering gold, silver, diamonds, lead, and other metals. August 27

10185 F. M. Lyte, London. Improvements in the manufacture of cupels in the cupellation of metals, and in the production of other refractory apparatus and materials. August 27

10237 O. Morton Thowless, Birmingham. Soldering aluminium and the preparing of aluminium for such soldering. August 29

10296 W. P. Thompson, Liverpool—Communicated by R. Tamine and E. de Cuyper, Belgium. Improvements in the manufacture of oxides of tin and tin salts. August 31

10491 L. A. Groth, London—Communicated by D. Mindeleff, United States. A method and apparatus for extracting nickel and cobalt from ores containing them. Complete specification. September 4.

10528 J. H. Williamson, London. Amalgamating, joining, soldering, and (or) autogenously uniting aluminium. September 5

10621 J. Dixon, F. J. Blades, W. Selby Douglas, D. Garlick and W. Malcolm, London. Improvements in the process of smelting pyrites and in the tuyeres of blast-furnaces to be used for the purpose, comprising also a novel method and apparatus for feeding such furnaces. Complete specification. September 8

10658 C. M. Pielsticker, London. Improvements in metallurgical apparatus. September 9

10698 C. Cochrane, London. An improvement in the working of blast-furnaces. September 9.

10712 W. Pritchard-Morgan, London—Communicated by F. Ellershausen, France. A process for separating silver from lead. September 10

XI.—FATS, OILS, AND SOAP MANUFACTURE.

9895 A. Lovell, London. An improved lubricating compound. August 20

10225 W. R. Lake, London—Communicated by T. Howard Jacobs and J. Yeatman Lockwood, United States. Improvements in the manufacture of oil, oilcake, and meal from Indian-corn or maize. August 28

XII.—PAINTS, VARNISHES, AND RESINS.

9982 C. D. Abel, London—Communicated by W. J. Wisse, Holland. An improved protective material for iron and steel. August 22

10311 W. Wells, London. An improved process for the production of carbon from refuse bark, to be utilised for the manufacture of paint, and for other purposes. August 31

10109 H. Gardner, London—Communicated by D. Lublinski, Germany. Improved compound for application to wood, metal, or other substance as a paint or varnish to prevent decay, rust, or other injury by atmospheric action (to be called Keralin). September 2

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

10147 J. C. Mewburn, London—Communicated by J. Marchal et L. Bories, France. A process of treating tannic extracts or juices. August 27

10562 W. Moore Riddell, Forest Hill. Improvements in the manufacture of tannin and the treatment of vegetable fibres to render the same suitable for various useful purposes. September 7

XV.—SUGAR, STARCH, GUMS, Etc.

10058 F. Wheaton Seabury, London. Improvements in method and apparatus for vulcanising rubber. Complete specification. August 25

10110 C. A. Henderson, London—Communicated by G. Durozad, France. An improved process for manufacturing sugar from amylaceous and cellulose matters. August 26

10172 P. Jensen, London—Communicated by M. C. P. Barbe, Holland. Improvements in the manufacture of refined sugar, and in apparatus therefor. Complete specification. August 27

XVI.—BREWING, WINES, SPIRITS, Etc.

9798 A. J. Boult, London—Communicated by A. S. Bigelow, United States. Improvements in pressure regulators for fermenting liquids. Complete specification. August 18

9817 P. M. Justice, London—Communicated by A. W. Billings, United States. Improvements in the manufacture of beer. Complete specification. August 19

9869 W. Whitson Crawford, Glasgow. Maturing of spirits in bottle or other non-absorbing vessels. August 20

9950 H. H. Lake, London—Communicated by A. E. Fewe, United States. Improvements in the manufacture of syrup and beer from maize or Indian corn and malt. Complete specification. August 21

9956 C. R. Bonne, Manchester. An apparatus for testing brewing materials. August 22

10358 M. Hedicke, London. Improvements in the drying of malt and in the construction of malt-kilns therefor. September 1

10527 H. T. Warne, London. Improvements in refrigerators for cooling malt liquors, wines, aerated waters, and other liquids. September 5

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

9806 H. Fisher, Chelsea. The filtration of smoke. August 18

9992 J. Clough Thresh, Buxton, and M. Hilton, Prestwich. The purification of sewage, sewage water, bleachers', dyers', and printers' effluent water, impure sewage and well water, and for the removal of organic matter from potable water; and for the application, utilisation, and recovery of all matters relating thereto. August 24

10123 W. J. Bishop, London. Mixing liquid disinfectants with water in any required proportion by means of an automatic apparatus. August 26

10124 A. J. Boult, London — Communicated by L. M. Rousseau, France. Improvements in the preservation and treatment of dried or cooked meats, and the manufacture therefrom of various articles of diet. August 26

10130 H. H. Lake, London—Communicated by C. Collin & Co., Belgium. The manufacture of an improved antiseptic. August 26

10137 W. Spence, London—Communicated by F. Sanders, Russia. Improvements in apparatus for removing sewage or other impurities from cesspools, sinks, and the like. August 27

10212 P. Ockenden, London—Communicated by H. Recke and H. T. Tompsitt, Australia. A new or improved antiseptic deodorant, and disinfectant compound. August 28

10332 W. Lucock, Birmingham. Improvements in the preparation and medication of cocoa, chocolate, coffee, and similar substances for beverages. Complete specification. September 1

10351 H. J. Haddan, London—Communicated by H. T. Baeschlin, France. A new frigorific or compound for producing cold. September 1

10379 J. Peachey, Worcester. Manufacturing sanitary urinals and disinfectants. September 2

10584 J. Stewart Edwards and J. Edwards, London. Improvements in apparatus for drying animal matter, fish, and other materials, applicable also for evaporating liquids. September 7

10604 F. Besshardt, London—Communicated by U. Egger, Switzerland. An improved apparatus for testing the quality of milk. September 8

10732 H. Compton, Palampur, East Indies. The desideratum desiccator for the rapid desiccating, drying, cooking, roasting, or evaporating of tea, fruit, hops, or any articles for which rapid or thorough desiccation is necessary, and especially for those articles which are injured by a damp heat. September 10

XIX.—PAPER, PASTEBOARD, Etc.

10092 J. Kenyon, London. Improvements in the manufactue of cotton and woollen drying felts used by paper makers. August 26

10313 G. T. Talbot, London—Communicated by J. Drew Gay, United States. An improved method of treating vegetable fibres for the manufacture of paper. August 31

10331 J. Plummer, jun., Edinburgh. Improvements in treating fibrous substances to prepare pulp for making paper, and for other purposes. September 1

10368 J. B. Alliott, London—Communicated by H. Lahousse, France. New or improved apparatus for treating or drying paper-pulp, textile fabrics, and other like substances. September 1

10513 C. J. Richardson, London. Improvements in apparatus for the manufacture of paper. September 5

XXI.—EXPLOSIVES, MATCHES, Etc.

9884 S. H. Emmens, London. Improvements in the construction of blasting cartridges, and in apparatus for using the same. August 20

10440 W. F. Ruston, London. Improvements in detonating fog signals for railways. September 3

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES

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Arthur Baggallay, l/o Calcutta, at Dunedin, New Zealand, August 20, 1885.

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R. B. Batty, Drayton Villa, Erdington, near Birmingham, metal works manager.
R. Bird, Ellerslie, Roath, Cardiff, tar and rosin distiller.
S. B. Bowen, Brickfield Chemical Works, Llanelly, South Wales, chemical manufacturer.
S. B. Brown, Strines, near Stockport, calico printers' chemist.

H. Dawber, jun., Kenmore, Waterloo Park, near Liverpool, chemical student.
S. M. Burroughs, Bell Lane, Wandsworth, S.W., manufacturing chemist.
Alf. J. Edwards, The Gas Works, Taunton, secretary and manager.
H. S. Elworthy, Rosa, N.W.P., India, sugar refinery chemist.
Adolf. Ernst, 238, Upper Brook Street, Manchester, chemist.
A. E. Fasnacht, 51, Arcade Chambers, St. Mary's Gate, Manchester, chemist.
J. A. Fermoy, 12, Railway Approach, London Bridge, S.E., oil expert.
H. J. Hardy, 163, Edmund Road, Sheffield, analyst.
T. E. Holgate, A.R.S.M., 146, Blackburn Road, Darwen, Metallurgist.
F. K. Hurman, Ryton-on-Tyne, chemical apparatus dealer.
S. Wright Lee, 7, Church Street, Liverpool, wholesale druggist.
J. Meadows, 1, Charles Street, Leicester, public analyst.
M. Ivor E. Morris, Ammanford, R.S.O., South Wales, colour manufacturer.
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A. G. Perkin, 56, Elizabeth Street, Cheetham, Manchester, technical chemist.
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R. Robinson, Apsley Buildings, Old Hall Street, Liverpool, general produce broker.
W. J. Rowley, 110, King Street, Manchester, chemist.
W. Lascelles-Scott, Chem. and Phys. Lab., Forest Gate, Essex, analyst.
Wilfred T. Skalfe, 630, Sherbrooke Street, Montreal, Canada, sugar refinery chemist.
W. Thompson, jun., Larkfield, Earlestown, Lancashire, sugar refiner.
H. H. Townsend, Avenue House, Cotham Park, Bristol, pharmacist.
E. S. Waring, Lillie Terrace, Castle Street, Sneinton, Nottingham, pharmacist.
J. W. Westmoreland, 25, Park Square, Leeds, analyst and assayer.

INTERNATIONAL INVENTIONS EXHIBITION, LONDON.

REPORT ON THE EXHIBITS RELATING TO THE CHEMICAL INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, Manchester, etc.

(Continued from page 527.)

GLASS, POTTERY AND EARTHENWARE.

Henry Knowles, Burton-on-Trent (*Group XXIII. No.* 1759).

Improvements in kilns :—(1.) Models of patent continuous or semi-continuous direct-action kilns. (2.) Models of patent detached down-draught ovens and kilns, with continuous direct action. (3.) Model of patent fireplace for kilns, ovens, glass and other furnaces. (4.) Model of patent binding for kilns, ovens, etc. (5.) Model of patent perforated bottom for kilns, ovens, etc. (6.) Samples of sanitary pipes, firebricks, tiles, terra-cotta, etc., burnt in H. Knowles' patent kilns.

Candy & Co., Limited, London (*Group XXIII. No.* 1763).

(1.) Patent vitreous buff, red and glazed terra-cotta. (2.) Patent terra-cotta and stoneware-facing and paving bricks. (3.) Patent kiln for burning these bricks and glazed stoneware, sanitary pipes and appliances.

Thomas Webb & Sons, Stourbridge (*Group XXIII. No.* 1768).

Various new methods and improvements in the manufacture and decoration of crystal and coloured glass, etc,

W. Douglas Herman, St. Helens (*Group XXIII. No.* 1773).

Improvements in the combination of refuse materials of glass-works with other substances for the purpose of making flags, bricks, tiles and other like fictile or vitreous articles; also filter stones, grindstones, etc., these improvements being also applicable to the case of similar materials from other sources than glass-works.

The Glenboig Union Fire Clay Co., Limited, Glasgow (*Group XXIII. No.* 1776).

(1.) Dunnachie's patent continuous regenerative gas kiln for burning fire-bricks, sanitary ware, pottery, etc., without smoke. (2.) Dunnachie's patent drying stove. (3.) Dunnachie's Star heating stove. (4.) Improved fire-clay and silica bricks.

Henry Braun, London and Paris (*Group XXIII. No.* 2719).

Specimens of fire-proof china, adapted for cooking utensils.

The Toughened Glass Co., Limited, London (*Group XXIII. No.* 1784).

Toughened crystal table glass, plain and decorated. Toughened lamp glasses. Toughened glass for chemical and laboratory use, etc.

F. Siemens, Dresden (J. Batt & Co., London) (*Group of Foreign Exhibitors, No.* 2720).

The manufacture of hard glass.

BUILDING MATERIALS, MORTARS, CLAYS, CEMENTS.

A. C. Ponton, Dorset (*Group XIV. No.* 1467).

Improvements in the processes of manufacturing artificial stones and concretes, so as to greatly reduce the quantity of silicate of lime, binding the sand and other aggregates.

Lime water, or the finest milk of lime, is boiled with either the finest sand, or dust from stoneware or natural stones, and a little soluble silica is introduced. Boiling under pressure would no doubt lead to the lime combining with the silica, but as this is inconvenient in practice, the fabricated articles after being dried in steam are boiled in a weak bath of silicate of soda. The silica, in separating from its solution of soda, combines with the lime forming crystallised silicate of lime, and the soda recombines with the free soluble silica. Sometimes the proportions of lime may render it difficult for the silica to penetrate through the mass; in this case dry powdered silicate of soda is rapidly introduced just before casting the stone or concrete. The dry silicate of soda fortunately takes a sufficient time to dissolve, so that chemical combination does not commence until the particles or aggregates are settled in position. This is important, since it was found that if the silicate of soda be introduced in solution amongst the "aggregates," disintegration ensues.

Still another method is open for adoption.

Even for artificial stone, as well as for concretes, a porous aggregate is often adopted, such as chips of stone, for the sake of conferring greater density. Advantage may be taken of this to introduce the silicate of soda into the fabric in a dry state, because it is easy for the porous aggregate to absorb weak silicate of soda, and subsequently lose the water by evaporation, and hence when such aggregates are incorporated with the stones or concretes the water introduced for producing plasticity forms a medium in which the chemical change of the lime into the

crystallised silicate can take place, as well as the recombination of the soda with the free soluble silica. The result of these methods is, as seen in the exhibits, that one part of lime binds together as much as 1000 parts of other aggregates, and it has been found by experiment that a certain amount of cohesion is even attained when one part of lime is mixed with 10,000 parts of other aggregates, but the cohesion is so feeble that the chemical recombinations cause disruption when the articles are boiled in the silica bath, although by taking precautions no doubt this difficulty could be overcome; thus, processes could be adopted in which the boiling would be unnecessary. It may be added that present manufacturers of artificial stone or concrete, as a rule, consider one part of cement to ten parts of other aggregates is the limit for successful manufacture.

METALLURGY AND MINING, ETC.

S. G. THOMAS AND P. C. GILCHRIST, LONDON (*Group II. No.* 156, *and XIV. No.* 1467).

The Basic- or Thomas-Gilchrist process for making steel and ingot-iron from phosphoric pig in the Bessemer and Siemens furnaces.

The exhibit comprises specimens of:—

(1.) The dolomite used for making the shrunk-lime lining material.

(2.) The shrunk-lime lining material before it is mixed with tar.

(3.) The lining material as used in the converter, prepared by grinding the shrunk material and mixing it with tar and heating to redness in a closed vessel.

(4.) The lime used for additions.

(5.) The steel and ingot-iron made.

(6.) The slag.

Of the steel and ingot-iron made there is a large number of test samples. These consist of specimens that have been tested very severely, both cold and hot, in the form of rails, girders, angles, beams, plates, tubes, wire, and black plates for tin plates. To illustrate how completely phosphorus can be eliminated, there are some samples of basic ingot-iron containing of phosphorus as little as 0·014 per cent., of C and Si traces, Mn = 0·05 per cent., S = 0·03 per cent., and Fe = 99·90 per cent., made by the North-Eastern Steel Company from phosphoric pig.

The basic Bessemer process is represented by the North-Eastern Steel Company, in England; Hoerder Hütten Verein, in Germany; Les Aciéries d'Angleur, in Belgium; and Messrs. Schneider & Cie., in France. The basic Siemens is represented by The Brymbo Steel Company, in England, and Messrs. Schneider & Cie., in France. There is also a casket presented to Mr. Sidney Gilchrist-Thomas at Vienna, the figures of which are cast from the same pig as is used in the basic Bessemer converter, and the repousée work is of basic Bessemer ingot-iron made by the Prager Eisen Industrie Gesellschaft, Kladno, Austria. Before the introduction of this invention little more than one-eighth part of the available supply of iron ore in the world could be used for the manufacture of steel, owing to the presence, in the remaining seven-eighths, of too much phosphorus. The presence of phosphorus in steel is a fatal objection to its employment for many purposes, owing to the brittleness conferred upon it. The problem therefore which urgently awaited solution up to the year 1879, was how to eliminate phosphorus in the Bessemer converter and Siemens furnace, from the pig-iron made from the abundant but phosphoric ores, so that phosphoric pig might be converted into first-class steel and ingot-iron.

The exhibit illustrates the manner in which this result is accomplished by means of the Thomas-Gilchrist process—namely, by certain modifications of the Bessemer and Siemens processes, the chief of which are the manufacture and application of a durable basic-lining, and the making of large additions of ordinary lime to the molten bath, the effect of which practically is, *the complete removal of the phosphorus from the bath into the slag.*

Prior to this invention the furnace linings used were composed of sand, and with such a lining large additions of lime could not be effectively made, because of the chemical action of the lime upon the sand, resulting in "corrosion" or destruction of the sand lining. The Thomas-Gilchrist process is now in use in all the great iron-making countries of Europe; the make of basic ingot-iron and steel being from 70,000 to 80,000 tons per month.

ROBERT OXLAND, PLYMOUTH (*Group II. No.* 115).

Improvements in calcining ores or minerals; especially applicable for the smelting and reduction of ores of gold, silver, copper, tin and zinc, and for the manufacture of arsenious and sulphuric acids.

F. JONES & CO., LONDON (*Group II. No.* 125).

Utilisation of blast furnace slag for the following purposes:—

The manufacture of mantelpieces, paving-blocks, bricks, sand, etc.; also the manufacture of a glassy fibrous material (slag-wool), used for fire-proofing and sound-proofing buildings, and for purposes for which it is necessary to prevent the transmission of heat, cold or sound.

METALLIC SULPHIDES REDUCTION CO. (HOLLWAY'S PATENTS), LIMITED (*Group II. No.* 130).

Improvements in the production of sulphur from pyrites and the separation of metalliferous and other substances therefrom by rapid oxidation without the aid of fuel.

ROYAL MINT, LONDON (*Group II. No.* 135).

Refining gold by the aid of chlorine gas. A process devised by F. Bowyer Miller, of the Melbourne Mint.

G. J. SNELUS, WORKINGTON (*Group II. No.* 136).

Illustrations of improvements in the processes for the manufacture of steel and in the apparatus used for that purpose:—

(1.) Illustrations of the basic process of dephosphorisation. Mr. Snelus was the first to discover and to demonstrate by experiment that in order to eliminate phosphorus from pig-iron by the Bessemer process the converter must be provided with a lime or "basic" lining, and not be lined with the ordinary siliceous material.

(2.) Apparatus for carrying hot steel ingots.

(3.) Improved steel linings for Gier's soaking pits.

(4.) Improvements in moulds for steel ingots, etc.

HENRY R. CASSEL, LONDON (*Group II. No.* 153).

Extraction of gold from refractory ores by electrolysis.

ELECTRO-AMALGAMATOR CO., LIMITED, LONDON (*Group II. No.* 154).

Improved method of extracting gold and silver from their ores by the combined action of electricity and mercury.

PHOSPHOR BRONZE CO., LIMITED, LONDON (*Group II. No.* 162).

(1.) Phosphor bronze alloys for bearings and parts of machinery.
(2.) Silicium bronze wire for telegraph and telephone lines, electric lighting, and other purposes.

MANGANESE BRONZE & BRASS CO., LIMITED, LONDON (*Group II. No.* 163).

(1.) Manganese bronze for heavy castings, such as propellers cast under pressure for ordnance purposes, forgings, shafts, sheathing, plates, bearings, wire, etc.
(2.) White brass for axle brasses, and for filling bearings.

PYRITES SMELTING CO., LIMITED, LONDON (*Group II. No.* 172).

Huntington and Koch's amalgamating apparatus, to be used in the process for extracting precious metals (gold and silver) from their ores. It is also termed the gold amalgamator, and is an apparatus by which the pulp from the stamps may be readily passed through a column of mercury a foot or more in height. Good results are said to have been obtained in Australia. Huntington and Koch also propose to extract silver from ores by passing these after roasting through red-hot molten lead by means of an apparatus similar to the gold amalgamator.

ERNEST SCOTT & CO., NEWCASTLE-ON-TYNE (*Group II. No.* 173).

This firm exhibits Scott and Hilder's machine for extracting iron from other substances by means of electro-magnetism. By the use of this process engineers' refuse and mould-borings are at once rendered valuable, whilst ore can be very economically worked. Special attention is invited to the automatic manner in which the iron is released from the magnets.

THE COMPRESSED LIME CARTRIDGE CO., LIMITED, LONDON (*Group II. No.* 177).

Improved method of and apparatus for breaking down and getting coal and other minerals in mining, quarrying or tunnelling operations, by which all danger of igniting fire-damp in coal mines is avoided.

GEORGE BOWER, ST. NEOTS (*Group II. No.* 198),

Exhibits drawings of a Bower-Barff Furnace, and specimens of iron and steel rendered incapable of rusting by a process which consists in subjecting articles when at a red-heat to the action of superheated steam or air, by which the iron combines with the oxygen, and produces a coating of magnetic oxide not affected by ordinary atmospheric conditions.

BOHLER BROS. & CO., SHEFFIELD (*Group II. No.* 209).

This exhibit is illustrative of a process for utilising the spathic and brown ores of the Styrian Alps in the production of steel by the direct process, only charcoal being used for fuel. Samples are shown of Bessemer and Bessemer-Martin steel from the same ores.

FATS, OILS, AND SOAPS.

J. VEITCH WILSON & CO., GLASGOW (*Group XIV. No.* 1433).

Improvements in the manufacture of lubricating oils and oil for batching jute.

MESSRS. ENGELBERT & CO., LONDON (*Group XIV. No.* 1435).

This firm exhibits a lubricant termed an "anti-corrosive lubricant;" it appears to be a high-boiling mineral oil, and is guaranteed free from acid, spirit, odour, and to be uninflammable under ordinary circumstances.

MESSRS. MACKEY, MACKEY & CO., LONDON (*Group XIV. No.* 1446),

Exhibit a series of vegetable, animal and mineral oils. The firm states the special advantages possessed by its lubricants to be—Freedom from acid and from gum, freedom from drying properties, a high flashing point, low solidifying point, and that the lubricants have no action on the working parts of machinery beyond keeping them bright and clean.

PRICE'S PATENT CANDLE CO. (*Group XIV. No.* 1469).

Specimens of fatty acids prepared from tallow, etc., by a new process. This method consists in decomposing tallow, palm-oil, etc., in an autoclave, by means of the magnesium salt of a fatty acid or acids. The magnesium is recovered for use again by means of an alkaline salt of a fatty acid or acids.

Specimen of soap made from tallow de-glycerised by the above method and for comparison therewith. Specimen of *Primrose Soap made from the same neutral tallow.

Specimens of crude glycerine prepared by the foregoing process from tallow, palm-oil, and cocoa-nut oil. These illustrate the improvement which has been effected of late in the quality of crude glycerine by the introduction of improved methods of "autoclaving"—*i.e.*, saponifying in an autoclave at a high pressure with the aid of water and a small percentage of lime, zinc, magnesia, etc.

Solidified Glycerine Soap.—Soap made transparent by the addition of 50 per cent. of glycerine, and without the use of spirit. Recommended for the use of those whose hands are liable to become chapped after washing.

Specimens illustrating a new method of rendering cloth-oil perfectly safe—*i.e.*, of checking oxidation, and so preventing spontaneous combustion when cotton or wool is saturated with the oil. This method consists in the addition of a small percentage of soap to the oleine. This addition not only makes the oil safe, but otherwise improves its quality, increasing its "body" or lubricating value, and rendering it more readily removable in the scouring process.

Candles and Candle-making, etc.—1. Specimens of paraffin, semi-refined and refined paraffin wax, refined without the use of naphtha or other solvent. 2. Specimens of Price's Gold Medal Palmitin Candles, which combine the virtues of high-melting point paraffin and palmitic acid. The paraffin supplies high illuminating value and transparency, while the palmitic acid adds that strength which is necessary to prevent the guttering and bending that occur when paraffin candles are burned in a warm atmosphere. Wax and spermaceti are now practically obsolete candle materials, and it is claimed for the palmitine candles that they exhibit in a high degree the valuable characteristics of the modern and comparatively inexpensive materials—paraffin and stearin.

Price's Co. exhibit the following patented novelties and improvements :—

(1.) *The Making of Palmitin Candles with ends that may be called "self- and tight-fitting."*—Each conical end is formed by means of a cap fitted into the expanded end of the moulding pipe, and consists of a series of sharp or V-shaped flutes, which are readily abraded when the candle is being fitted

* "Primrose Soap" here means a best tallow soap like "XXX" or "Honey Pale Soap" of the North of England and Scotland, where, however, "Primrose Soap" signifies a common and "highly run" article, containing from 46 to 49 per cent. of water, a freshly made curd soap of the best quality, containing not more than 34 per cent. of water.

into a candlestick. The caps are removed from the candles in a novel and ingenious way. They are laid on a popping-table attached to the machine, and the row of candles is simultaneously and instantly cleared from the caps by a series of wooden pistons moved by a lever.

(2.) *The Moulding of Spiral Candles.*—Hitherto such candles have been prepared one at a time by cutting, but now Price's Co. mould them 96 at a time. The winding of these screw-shaped or spiral candles out of the rifled moulds is as pretty as it is novel, and has attracted much attention.

(3.) *The old style of Making Candles is illustrated, but with a modern improvement.*—Dips are still consumed, but they are now made self-snuffing. Messrs. Price have introduced a new way of making them. Instead of dipping the wicks they dip a series of steel skewers into the candle material, and after the candles have been formed and cooled, the steels are removed, and the wicks, cut to the required length and specially prepared, are inserted. This method entirely prevents the waste of wick which characterised the old style of dipping, and the saving effected covers the whole cost of the candle-maker's labour.

An improved wick-making machine is shown at work. In this machine an improved switching arrangement has been introduced, which renders possible the employment of large bobbins running at high speed.

All the novelties and improvements exhibited have been invented by officers of the company, and all the candle machines shown are of the company's manufacture.

J. & J. C. Field, London (*Groups XIV. and XI. Nos.* 1469 and 1192).

This well-known firm exhibits specimens (1) of soaps, (2) detergents, (3) disinfectants, (4) night lights, (5) candles, and (6) candle machines.

F. C. Calvert & Co., Manchester (*Group XIV. No.* 1466),

Exhibit samples of their well-known carbolic acid soaps. (See p. 475.)

J. Alexander & Co., Lambeth, S.E. (*Group XIV. No.* 1447),

Exhibit as a specialité a delicately-scented toilet soap, composed of the purest ingredients, and into which is introduced the extract of the fresh bark of the *hamamelis virginica* or common witch-hazel, which is known as "hazeline." This essence, chiefly composed in all probability of a phenolic substance, possibly analogous to *eucalyptol*, is distilled from the fresh green bark of the hamamelis, and has long been known as a valuable astringent remedy. According to the *Lancet*, "it has a fragrant odour and a cooling taste, and has a high reputation in the United States, where it is used in the treatment of eczema, ulcers, burns, etc. It has undoubtedly the power of arresting many forms of hœmorrhage." It is also stated by the *Medical Press and Circular* to be an admirable substitute for arnica, in all cases where the latter is usually prescribed, at the same time possessing advantages not offered by arnica. "Hazeline" is a colourless oil, possessing a peculiar, pleasant and pungent odour, and sweet astringent taste. It does not stain or soil, and produces a soothing and cooling effect when applied to irritated surfaces.

PAINTS, VARNISHES AND RESINS.

The Sankey White Lead Co., Warrington (*Group XIV. No.* 1467).

The "white lead" originally produced was, it is stated, deficient in density, and although possessing great opacity and a covering power superior to nearly all Dutch-made "white lead," was not liked by grinders, because its larger bulk when dry caused it to take longer to mix. This objection is now removed in an improved method of working, and a lead weighing 200lb. to the cubic foot is produced, without the other good qualities of the article being in the slightest interfered with. Still more important, however, is the announcement that by means of the improvements introduced in Mr. Ed. Milner's patent (Eng. Pat. 4053, November 22, 1875), this firm will very shortly be manufacturing that poisonous substance without the necessity of its being handled by the workmen in any way. On August 10, 1869, a patent (No. 2443) was taken out by J. Gallemore Dale and E. Milner, afterwards one by E. Milner (June 22, 1872, No. 1881). The improvements in the last patent are more especially in reference to the 1872 patent.

Finely-ground litharge is taken and mixed with a solution of common salt, in the proportion of 4lb. of dry litharge to 1lb. dry salt, the salt being dissolved in 16 parts, by weight, of water. The mixture is thoroughly agitated for about 4½ hours. The result is an insoluble basic chloride of lead. This basic chloride is now suspended in a solution of caustic soda and common salt. The mixture is then introduced into a lead-lined vessel, fitted with wooden beaters, and there subjected to the action of carbonic acid, beyond the point at which it ceases to show an alkaline reaction. The proper point of saturation is ascertained by a simple test, easily applied by the workmen. When the solution has ceased to show an alkaline reaction, the mixture is a viscid homogeneous mass, and if a portion be shaken in a half-empty glass, it will coat the sides and remain in a layer all over them; but when sufficient gas has been supplied, a small quantity shaken in a clear glass vessel coats the sides with a very thin layer, like frost on a window pane, and after standing for a few seconds the clear liquid separates from the carbonate of lead and leaves an arborescent pattern on the interior of the glass. Should this action of the gas have been continued too long, the product loses its value, becoming like sand, and not coating the glass at all, but settling rapidly out of the solution of salt.

The workpeople can tell to the greatest nicety, by this test, when to stop the supply of gas.

The carbonate of lead thus produced, after being washed to free it from salt, and being dried, is ready for use, and is stated to be of greatly-improved quality, compared with that formerly produced by the former patented method.

Thos. Griffiths, Oxton, Liverpool (*Group XIV. No.* 1443).

"GRIFFITHS' PATENT ZINC WHITE" (SULPHIDE OF ZINC).

This pigment is manufactured by Messrs. Griffiths, Berdoe & Co. (the Sanitary Paint Co., Limited), of Liverpool and London. It is claimed for this article that besides being non-poisonous, "it covers one-third more than white lead, and 100 per cent. more than zinc oxide." It is said to have no chemical action upon metals, if not discoloured by foul gases or bilge-water, is fire-proof and unaffected by a red heat. It is also said that most delicate tints or "tones" can be produced with it, not possible with lead. This zinc white is produced as follows:—Either zinc

chloride or sulphate is precipitated by a soluble sulphide—sodium, calcium, and barium sulphides all having been used for the purpose—and precautions are taken lest any iron that may be contained in small quantities as an impurity in the zinc solution, should be precipitated with the sulphide of zinc. The precipitate being collected and dried, is transferred to a furnace, where it is calcined, and after careful stirring it is raked out, whilst quite hot, into vats of cold water, where it is levigated, and afterwards collected and dried. The result is stated by Dr. T. L. Phipson to be a white pigment of exquisite beauty, and possessing a covering power, when mixed with oil, greater than that of any known substance. Phipson's analysis shows that the substance consists of an oxy-sulphide of zinc, the composition of which varies somewhat, according to the duration of the calcination and the exact degree of heat attained. The best product appears to correspond very closely with the composition indicated by the formula $5ZnS + ZnO$. (See *Journ. Chem Soc.* for December, 1878.)

H. Bollman Condy, London *(Group XIV. No.* 1445).

The specimens exhibited illustrate what is termed a *new rapid innocuous* process for the manufacture of white lead $[2(PbO,CO_2)+Pb(OH)_2]$ of the finest colour and body, of the exact composition of white lead made by the old Dutch process, and of equal density. In this process the workmen are not under the necessity of handling the white lead until the completion of the manufacture, which is effected in seven days, whereas by the old process four or five months are required. The body of this pigment is such that it requires to be ground with from 12 to 13lb. of refined linseed oil to the cwt. At first it appears somewhat thin, but in the course of twenty-four hours it will be found to be firm, and to have, it is said, the quality which has hitherto only been found in white lead which has been ground some months.

Donald Macpherson & Co., Manchester (*Group XIV. No.* 1469),

Exhibit specimens of the so-called Foo-Chow signal paints, a kind of enamel paints, possessing all the long-sought-for characteristics of the Chinese enamels, so much admired for their hardness and brilliancy on tea-trays and papier-maché articles imported from China. The paints have, on drying, an extremely hard, tough, glossy surface, are not affected by sulphuretted hydrogen and will not crack, blister, or scale off. They dry in five minutes, when a second coat can be applied.

The Foo-Chow lacquers are also valuable for printing pillar letter-boxes, and to machinists, japanners, or for any manufacturers who have to turn out their goods as soon as they are finished, and yet desire a highly-enamelled surface.

J. B. Freeman & Co., Battersea, S.W. (*Group XIV. No.* 1448).

This firm shows specimens of its patent "non-poisonous white lead," which mainly consists of lead sulphate of a specially prepared kind. This form of white lead is, according to the testimony of Prof. A. H. Church, superior to the best white lead made by the Dutch method, and is besides said to be really non-poisonous, both as regards workmen making it or using it. As an oil paint, it is free from the disagreeable odour of the ordinary article when ground in oil. In density, body and covering power, as well as in smoothness and the purity and beauty of its whiteness, Freeman's paint is at least equal to the best white lead of the old processes, and in some of the qualities named it is superior. Dr. H. C. Bartlett has proved by photometric observation of the quantity of light reflected by various samples of the purest zinc white, and by Freeman's white lead, that the whiteness of the latter exceeds that of the former. According to Prof. Church, when submitted for varying periods to the action of air containing sulphuretted hydrogen, surfaces of this paint remain unaffected, or were only very slightly tinged. It does not turn yellow or buff when a surface painted with it is excluded from light for some time—a well-known drawback in the use of white lead.

Now, though the basis of Freeman's "non-poisonous white lead," as already stated, is sulphate of lead, yet the pigment does not consist merely of sulphate of lead; also, the sulphate employed is no mere by-product, but is specially prepared from metallic lead. Many attempts have been made to utilise lead sulphate as a pigment, but without success, the product being quite useless, possessing neither the necessary density, body nor opacity. Moreover, a large quantity of oil is required in grinding it, and as a paint it is what painters term "slimy," and works very badly under the brush.

It was found, however, that by adding about 25 per cent. of zinc oxide (in itself a substance possessing neither good body nor density), and subjecting the mixture to great friction and pressure under heavy edge runners, a complete change is effected in the characters of the substances employed, which it would appear impossible that any mere mixture could effect; and a pigment possessing great density and opacity, and of exceeding whiteness, is the result. The whiteness is said to be greater than that of the finest white lead made by the Dutch process. As regards density, 3 cubic feet of lead sulphate, weighing 170lb. per cubic foot, and 1 cubic foot of zinc oxide, weighing 58lb., when mixed together and treated by the above process, yield the pigment in question, weighing over 200lb. per cubic foot.

The following experiment was made by Prof. Church, with this white pigment, and the description of it is given in his own words:—

"On a sheet of glass three large patches of three different paints were spread with a spatula. The three paints were all ground in linseed oil, they being respectively, (A) Freeman's white lead; (B) Dutch process white lead; (C) zinc white. The sample C had been ground in oil so long ago as 1879. Before the patches of paint had dried at all, a few drops of dilute sulphuric acid (Brit. Pharm. strength) were poured upon them and well mixed with an ivory knife. No saponification with C has occurred, and, therefore, no mixture of acid and paint could be effected. With B the saponification of the oil was complete. With A, saponification had occurred to a very marked degree, quite sufficient for the purpose of causing the paint when dry to produce a tough homogeneous film, not liable to break up into powder by exposure to weather or wear."

Messrs. Freeman also exhibit a case of non-poisonous colours (pigments) of almost every variety of shade.

T. B. Orr & Co., London (*Group XIV. No.* 1467).

This firm exhibts specimens of the so-called Hygienic Paints, the principal ones being the "Charlton White" and "Duresco." The processes by which these paints are produced by Messrs. Orr & Co., are somewhat as follows:—"Barytes" (heavy spar), and "Celestine" native strontium sulphate, are finely ground and mixed with ground coal, and the mixture, of a "leaden hue," is repeatedly roasted at high temperatures in four furnaces. The charge drawn from the fourth furnace, and consisting of the sulphides of the alkaline earth metals, is carried to an upper floor in waggons, and then thrown into a

large pan and mixed with water. After settling, the greenish solution of the sulphides is pumped up to a large receiver on the top floor of the factory. Meanwhile, on the roof is a cistern in which pure zinc is treated with a mixture of sulphuric and hydrochloric acids, until solution is effected. The metallic zinc is especially made from poor calamine; this calamine sometimes contains copper, which is carefully removed from the zinc, or damage would result. The zinc solution is drawn off by pipes, and conveyed to a tank on the lower or first floor, and into this same tank is drawn the green coloured solution of barium and strontium sulphides from the tank on the upper floor, and the solutions are thoroughly mixed. In the barium tank is usually a large residue of undissolved sulphides and probably undecomposed sulphates. This is taken outside, thrown in heaps, and exposed for some time to the air, when it frequently loses its black sludgey appearance and turns yellowish-green. At this stage it is again furnaced, and then once more lixiviated. The milky liquid obtained in the cistern where the zinc sulphate and chloride are mixed with the barium and strontium sulphides, is run into pans and allowed to settle, when after a time it assumes a semi-solid form, when it is removed and pressed till the mass appears like moist pipe-clay, when it is taken and dried at a gentle heat on stone beds over flues. From these beds the dry pigment, thus chiefly a mixture of barium and strontium sulphates with zinc sulphide, is taken and thrown into a furnace, where it is subjected to an intense heat for several hours, when it is drawn out and plunged into cold water. This treatment is said to confer "solidity" and "density" upon the paint. The paint is now well-ground in water by a grinding stone; as it becomes more and more attenuated, it rises with the water, becoming mixed with it, and overflows through a pipe, which carries the finely-ground white into a second vat fitted with another set of grinders of a different kind. Attached to this second vat is a pump which draws off the white liquid, and conveys it through pipes to another department where it is emptied into a series of capacious cisterns; in these it is allowed to stand until the solid matter is settled out, when the water is syphoned off. The white is then taken out and pressed. The press residue is afterwards taken and placed on small wooden trays made of narrow ribs of wood, and these trays are carried into a drying stove. When completely dried, the pigment is ready for mixing with linseed oil, and is the substance known as "Charlton White." "Duresco" is a so-called distemper, made from "Charlton White," and will, it is said, when applied to walls, ceilings, etc., stand washing extremely well, is non-poisonous, and impervious to damp.

The Continental Diamond Rock Boring Co., Limited (*Group XIV. No.* 1444).

Specimens illustrating a process for manufacturing white lead pigment.

The Patent Liquid Fireproof Cyanite Paint Co., Limited (*Group XIV. No.* 1440),

Exhibits specimens of coloured cyanite. The "Fireproof Cyanite" is a liquid which may be procured either colourless or coloured for staining wood, canvas, felt, etc. It is also used as a priming for paint, varnish, etc. Combustible substances, such as those named, coated with it, are certainly rendered completely uninflammable. Some wood chips sent to the writer, as having been coated with the preparation, were found slightly covered with a whitish powder almost like an efflorescence, and on wetting were found to taste, as well as to react, strongly alkaline. This being the case, the fire-proofing liquid is not unlikely to be a mixed solution of silicate of alumina and silicate of soda (or soluble glass). In any case the chips of wood refuse to burn in a flame, and only slowly char. The wood that has been impregnated was found to have preserved its integrity perfectly. Besides communicating nothing of a poisonous nature to the wood, it is claimed that the treatment with this liquid prevents dry-rot, and that only one coating is needed. According to the testimony of the *Builder*—"Two wooden structures, one only coated with the above-named preparation, the other not coated at all, were fired; the one coated withstood the action of the flames, whilst the non-coated building was destroyed." *Engineering*, referring to the coated building in the experiment, states that "the prepared building was merely scorched." Captain Shaw, C.B., Chief of the London Fire Brigade, considers that "wooden stairs cyanited are, in case of fire, much safer than stone." The small experiment with the cyanited chips certainly bears out this statement, for a similar fragment of stone exposed in a flame to a temperature at which the wood is only commencing to char, would have cracked and flown to pieces.

Messrs. Bolton & Partners, Limited, Bristol (*Group XIV. No.* 1452).

(1.) Specimens of strontia paints, colours and glazes; and (2.) Specimens illustrating certain improvements in the manufacture of caustic soda.

TANNING, LEATHER, GLUE, AND SIZE.

The Eglinton Chemical Co., Glasgow (*Group XIV. No.* 1441).

This firm exhibits specimens illustrating the chrome-tanning of leather, and articles made from the leather so tanned. (See this Journal, iii. pp. 615—620).

T. Nordenfelt, London (*Group XIV. No.* 1439),

Exhibits specimens illustrative of his new methods of extracting albumen, fish-oil, glue, gum, etc., from fish, and of preparing guano from the residue.

B. Cannon & Co., Lincoln (*Group XIV. No.* 1438),

Show samples of concentrated size and glue powders made by their firm.

AGRICULTURE, MANURES, Etc.

The Agricultural and Horticultural Association, Limited, London (*Group XIV. No.* 1455).

Specimens are shown of various improved artificial manures, suitably classified according to the crops which they are intended to promote. An interesting and able account, not suited for reproduction here nor yet for useful abstraction, is presented by the Association, and it treats in detail of the different manures made, the crops for which they are suited, and the proportions of the constituents composing these manures, with prices.

Among certain directions given for the valuation of compound manures by analysis, is one which runs as follows:—

"Great care is required in sampling a compound manure for analysis. A small portion should be drawn from almost every bag, and these small lots carefully mixed together. *All dirt, stones, etc., which would vitiate the result, should be carefully excluded.*" (The italics are the writer's.) After the preceding direction appears the following:—

"As analysts differ in their results, we must claim the right to have a second analysis made by a second

chemist, if necessary, and to strike an average of their results." It would seem, however, that the "great care required in sampling" above referred to, would lead the readers of the sentence in italics to regard that sentence in very different lights, according as they are buyers or sellers of a manure! Moreover, not unlikely "analysts differ in their results" more or less in proportion as "great care *is*" exerted "in sampling" by buyers and sellers respectively!

The directions for the use of common salt in manuring are interesting. It is stated that salt should be used in conjunction with almost all manures, whether farm-made or artificial. "It is especially advantageous for mangels, cabbages, kohl-rabi, kale, potatoes, etc. It sweetens pastures, and where used is said to be an antidote to several diseases of sheep and cattle. It is best mixed with manures just before they are used, as otherwise it has a tendency to cause them to get damp." The following various kinds of salt are supplied by the Association:—"Agricultural salt, ground rock salt, clean broad salt, fish salt (containing some ammonia), saltpetre salt (containing some potassium nitrate), hide salt (containing some ammonia)."

In the *directions for use* it is stated: "For potatoes, turnips, mangels, carrots, old-laid grazing lands and sour pastures, from 5 to 10cwt. are sown broadcast in the early spring." "Farmyard manure should be regularly salted, while compost heaps of earth and lime would be greatly improved and give better results by the addition of a little salt." "Nitrate of soda, and similar strong nitrogenous manures, should be mixed with three or four times their weight of salt before sowing." It would thus appear that sodium chloride, by virtue of its ready solubility and osmotic power, plays a part in assisting in the assimilation and digestion of manurial and earth-food by the plant, similar to that played in the animal economy when salt is partaken with food by man.

EDWARD WEBB & SONS, WIDNES AND STOURBRIDGE (*Group XIV. No.* 1456),

This firm exhibits (1) samples of Webb's manures for all crops; (2) raw materials from which the manures are manufactured.

CLAY & LEVESLEY, LONDON (*Group XIV. No.* 1456),

Show samples of Clay's fertiliser, a special horticultural manure.

EDWARD PACKARD & CO., IPSWICH (*Group XIV. No.* 1454),

Exhibit specimens of concentrated superphosphate, and also phosphates of soda, potash and ammonia, with other compounds, manufactured by processes protected by letters patent (Eng. Pat. 2182, May 31, 1878), in which also the use of a special form of mixing apparatus for assisting in dissolving phosphates, is comprised. The mode of separating the gypsum and solid mass from the superphosphate solution by means of filtering presses, particularly wooden ones; the mode of concentrating the superphosphate solution so obtained, and several other processes connected with the manufacture of superphosphate, etc., are also patented. (See Eng. Pat. No. 6176, April 9, 1884; also Nos. 6750, 6751, and 6752, April 24, 1884.)

The chief feature of novelty is the cheap method of manufacturing a concentrated form of phosphoric acid (superphosphate). If bones be reduced to a meal and added to a syrup of this concentrated superphosphate, and after thorough incorporation the mass be thrown in a heap and allowed to remain for a few weeks, it will gradually dry and become friable, and in a fit state to be applied to the soil. Phosphatic guanos may be treated in a similar manner.

J. SIMON-LEGRAND, BERSÉE, FRANCE (*Group I. No.* 2705),

Apparatus for forcing or germinating grain.

SUGAR, STARCH, GUM, &c.

EDWARD PACKARD & CO., IPSWICH (*Group XVII. No.* 1564),

Exhibit specimens illustrating their improvements in the manufacture of sugar from cane-juice. These comprise samples of sugar made in the Mauritius under the new process invented by Messrs. Icery, Bernard & Ehrmann, and patented by them. By the use of this process, great economy is claimed as being effected in the manufacture of cane-sugar.

This firm exhibits, further, various reagents used—the processes referred to, including a particular form of phosphoric acid, really a crystalline superphosphate termed "Ehrmannite," which is entirely soluble in water, and the manufacture of which is patented by the exhibitors. There are two qualities of this superphosphate, the "A" quality containing about 55 per cent. of soluble phosphoric acid, and "B" about forty per cent. Before use, the substances are dissolved in cane-juice or water. In these they are easily soluble.

These superphosphates are used in the following way:—The usual process of defecating the cane-juice is carried out by adding lime until the point of neutralisation is reached. The juice is then "over-tempered," half as much lime again being added as had been required to neutralise the raw cane-juice. The solution of the superphosphate is then run in, until the excess of lime purposely used is precipitated, and the neutral point again attained. The resulting liquor, when drawn off, is found particularly clear and free from objectionable extraneous matters. The advantage of the use of the superphosphate arises from the floccular nature of the precipitate it forms with lime, for this mechanically collects along with it all the suspended matters in the juice, throwing them to the surface in the usual process of "cracking" the liquor, as it is termed in the West Indies. The mud from liquor so defecated is valuable for manure from the extra amount of precipitated phosphate of lime it contains.

BOLTON & PARTNERS, LIMITED, LONDON (*Group XVII. No.* 1561),

Show specimens illustrating their improvements in the treatment of saccharine juices, and the manufacture of oxide of strontium for the production of refined sugar direct from beets.

J. A. R. & J. DUNCAN, AND B. E. R. NEWLANDS, LONDON (*Group XIV. No.* 1449).

(1) Alum process for removing potash from saccharine solutions; (2) Improvements in the manufacture of sulphate of alumina.

On referring to Eng. Pat. 2090, 1871, by James Duncan, John A. R. Newlands and Benjamin E. R. Newlands, it will be found it treats of what is commonly known as the "alum process" for removing potash, ammonia, and other impurities from saccharine solutions.

Cold solution of sulphate of alumina is added to the cold syrup in quantity sufficient to form an alum with the whole of the potash present. The mixture

is well stirred for a few minutes, and then allowed to repose for a few hours, when the alum falls to the bottom of the vessel, and the clear acid liquor is then removed by decantation.

The acid liquor is next neutralised by milk of lime. The liquor is afterwards heated and filtered. It will then be found that a large part of the mineral matter has been removed, and also a good deal of organic impurities. The alum produced has a ready sale, being remarkably free from iron. During the past few years, five thousand tons of this potash-alum have been produced at Mr. James Duncan's sugar refinery, Clyde Wharf, Victoria Docks, London.

In connection with this process, the following samples are exhibited :—The solution of sulphate of alumina used and the alum produced, the latter in the form of alum-meal and of a large crystalline block. The syrup is shown before treatment, also after addition of sulphate of alumina (with the deposit of alum), and, lastly, after completion of the process.

Eng. Pat. 5287, 1880, by B. E. R. Newlands, covers a process for the manufacture of sulphate of alumina containing very little iron or free acid. Solution of sulphate of alumina, containing more or less impurities, is concentrated until it partially solidifies on cooling, to form a magma, or mass of crystals. This magma is pressed in a filter press, and cakes of sulphate of alumina are thus obtained containing scarcely any free acid, and only a very small amount of iron.

The residual mother-liquor is concentrated by heat till it is sufficiently strong to give a magma of crystals on cooling, and this second magma is submitted to pressure as before, and yields a tolerably pure sulphate of alumina. The same operation may be repeated, and the impure mother-liquor finally left yields a sulphate of alumina containing a considerable amount of iron. This sulphate may be used for the purification of sewage, or for any other purpose for which sulphate of alumina is required, and in which the presence of iron is not objectionable.

In connection with this process the following samples are exhibited :—The Eglinton alum-clay used in making the sulphate of alumina ; the concentrated solution of sulphate of alumina with the magma in it ; and the first quality, second quality, and residual products obtained.

GUSTAV FRITSCHE, MORAVIA (AGENT, P. BORN, LONDON) (*Group XVII. No.* 2704),

Show samples illustrating the improved method of the above-named, for refining beetroot sugar-juice.

ADOLPH LIST, LEIPSIC (*Group XVII. No.* 2705*a*),

Exhibits specimens of saccharine made from coal-tar.

(*A*) FOODS, (*B*) SANITARY CHEMISTRY, (*C*) DISINFECTANTS.

(A) *FOODS.*

HOLLANDIA, FABRIQUE DE PRODUITS DE LAIT, NETHERLANDS (*Group XVII. No.* 2715).

Samples illustrating the process of this firm for preserving milk and cream without sugar.

This condensed milk is prepared at the manufactory, "Hollandia," near Rotterdam, the only addition to the milk being the required amount of sugar to act as a preservative after the tin is opened, and only the best cane-sugar is employed for this.

The milk is moreover condensed and conserved without the addition of any foreign matter. The condensed cream consists of the pure article.

JOHN FORDRED, LONDON (*Group XVII. No.* 1569).

Specimens of (1) Malted food preparations—viz.: (*a*) Allan & Hanbury's malted farinaceous food and malted jelly ; (*b*) Hill & Sons' malted nursery biscuits. (2.) Samples of torrefied grain with model—viz.: (*a*) Barley, maize, rice, etc., for brewing, distilling, and vinegar making ; (*b*) Maize prepared for horse and cattle food by the Torrefied Grain Company. (3.) C. Spencer & Sons' malted cake for cattle feeding.

(B) *SANITARY CHEMISTRY.*

THE PATENT POROUS CARBON CO., LIMITED, LONDON (*Group XIV. No.* 1459).

This company illustrates its methods for deodorising sewage, for filtering water, refining sugar, and for the decolourisation and purification of liquids by means of a patent carbon. Plans also of patent carbon closets, etc., are shown.

(C) *DISINFECTANTS.*

H. B. CONDY, BATTERSEA, S.W. (*Group XIV. No.* 1445),

Exhibits specimens of (1.) A new permanganate disinfectant, which contains also aluminium sulphate, which, it is said, increases the oxidising effect of the permanganic acid, plays a useful part in neutralising ammonia, and adds antiseptic value to the preparation. In this new disinfectant, all the available oxygen of permanganic acid is utilised, whereas only 60 per cent. of this amount is utilised with the alkaline permanganates. (2.) A new medicinal salt, sodium hyposulphate, and also other hyposulphates.

J. MARTIN SMITH, LONDON (*Group XIV. No.* 1422),

Shows specimens of disinfecting cleansing powder.

PAPER, PASTEBOARD, &c.

THE CHEMICAL PAPERS CO., LIMITED, LONDON (*Group XIV. No.* 1460).

Illustrative specimens of (1) improvements in the manufacture of papers and felts for protective, antiseptic and germicidal purposes ; (2) moth-destroying papers ; (3) anti-tarnish and building papers.

HENRY NEWALL & SONS, MANCHESTER (*Group XXVI. No.* 1986).

Specimens of (1) mechanical and chemical wood-pulps ; (2) wood-flour, etc., used in the manufacture of paper, linoleums and other fabrics.

T. GRAHAM YOUNG, DURRIS, ABERDEEN (*Group XXVI. No.* 1992),

Illustrates his chemical process in the preparation of wood-pulp, with suitable samples.

W. M. RIDDELL, LONDON (*Group XXVI. No.* 2004),

Illustrates the manufacture of paper, paper boards, waterproof paper, and other articles of a fibrous texture from waste bark.

G. F. GREEN & CO., LONDON (*Group XXVI. No.* 2044).

Specimens of wood-pulp boards and wood-papers made by their firm.

THOMPSON & NORRIS MANUFACTURING CO., LIMITED, LONDON (*Group XXVI. No.* 2043),

Exhibit samples illustrating their improvements in the manufacture of corrugated paper to be used as a packing material and parcels post wrapping.

THE DANZIGER CELLULOSE FABRIK (AGENTS, C. F. GREEN & CO., LONDON) (*Group XXVI. No.* 2653).

The following are the details of this exhibit :—

1. Specimens illustrating the stages of the manufacture of chemical wood-pulp (soda process).
2. Samples of pulp manufactured by the new sulphate process, and of paper produced from this material.
3. Samples of wood-pulp boards and fancy boxes made from them.
4. Samples of pure wood middles for card-making.
5. Samples of tinted wood cartridge-paper or boards for tickets, etc.
6. Samples of pure wood wrapping-paper.
7. Samples of mechanical wood-pulp.

(Nos. 4, 5 and 6 are made from this kind of pulp—*i.e.*, mechanically-ground wood).

FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

BRIN FRÈRES, PARIS (*Group II. No.* 138).

THE INDUSTRIAL PRODUCTION OF OXYGEN AND NITROGEN, AND THEIR SEPARATION FROM ATMOSPHERIC AIR.

Anhydrous barium oxide is first prepared, then placed in a kind of tabular retorts arranged in series, and heated to between 500° and 600° C., atmospheric air, which has been previously deprived of carbonic acid and moisture, being passed over it. The oxygen is absorbed, barium peroxide is thus produced, and the partially-exhausted air is passed through other retorts of the series until at length all the oxygen is said to be absorbed, and nitrogen passes on to a gasholder. The temperature is regulated by means of a pyrometer specially constructed, so that at the end of the pyrometric bar a lever is fixed which holds a suspended disc, so adjusted as to proportion exactly the mixture of air and carbonic oxide employed as fuel. This bar, in expanding, closes the disc-valve or clapper which admits the air to the furnace, and there is at once a fall of temperature to 500° When the pyrometric bar contracts, the valve is again open, and the temperature rises to 800°, and at 800° deoxidation of the barium peroxide produced is said to take place, pure oxygen being of course evolved. Thus great regularity in the heating of the retorts is said to be obtained, a considerable saving in plant through the danger of overheating being prevented, not to speak of the perfection in working, all independent of the attention given to the furnaces by the workmen. The apparatus works in a precise, because in an automatic way ; for a disc or a single valve when shut virtually produces the peroxidation, and when open, the deoxidation, by the action of the pyrometric bars already mentioned. Messrs. Brin Frères calculate that 1kilo. of anhydrous barium oxide produced by their process will give at the first operation 25 litres of oxygen. The production will increase from day to day, and they have observed that after eight days of continuous working this same kilo. will produce 68 litres of oxygen. They claim, therefore, that in a regular course of production, they can count upon an average return of 50 litres of pure oxygen for every kilo. of anhydrous barium oxide for each operation.

Description of the Apparatus.—The barium oxide is placed in iron retorts, set in horizontal layers or batteries. These retorts have at each of the ends metallic friction joints. For the complete demonstration of the process, Messrs. Brin Frères have at their shed in the Exhibition coupled two furnaces, each with 15 retorts of 2·80 metres in length, and 0·16 metres diameter inside measure. Two double-acting pumps communicate with these batteries, one of the pumps drawing air into the retorts, and so into contact with the barium oxide, when peroxidation takes place. The other pump creates a vacuum in the retorts at the proper time, and when the temperature rises to 800°, and draws off the oxygen, which had combined with the baryta, to form peroxide of barium. The air before entering the retorts is deprived of carbonic acid and moisture by passing it through the chambers of an apparatus containing quicklime or caustic soda. The coupling of the two furnaces allows of the direction, by means of pipes and valves, of the peroxidation or deoxidation, or one or other of the two furnaces, as may be desired.

The experimenting establishment of Messrs. Brin Frères is large enough to enable them to produce 100 cubic metres of pure oxygen per diem, and this is of course more than mere laboratory work.

The oxygen produced is quite free from the small quantities of chlorine found in the gas generated from potassium chlorate, and which interfere with its use for medical purposes.

The Nitrogen ; its Collection and Employment.—A simple change of valves at the outlet of the retorts makes it possible to send each gas into its respective gasometer. For every cubic metre of oxygen about four cubic metres of nitrogen are obtained. The latter element it is proposed to utilise, and the method to be adopted is experimentally illustrated by the exhibitors. The medium, or reagent, chosen for effecting the synthesis of the nitrogen and hydrogen is a very thorough mixture of finely-divided carbon and caustic baryta. This mixture is placed in retorts, and nitrogen, previously rendered moist by bubbling it through water, is passed through them, their temperature being maintained at 150° C. The steam at this temperature is, according to the inventor, decomposed, the affinity of baryta for carbonic acid being apparently powerful enough to determine the formation of the latter, whilst nascent hydrogen unites with the nitrogen, forming ammonia, which, passing on, is absorbed by sulphuric or hydrochloric acids, or otherwise treated.

VARIOUS APPLICATIONS :—*Oxygenised Water.*—Oxygen is forced into water under high pressure, and a beverage is produced, which, it is said, medical men have experimented with very successfully in the amelioration or cure of certain disorders. That the water is charged as stated, is easily proved by the simple experiment with a red-hot match on opening the tap of one of the syphon-bottles containing the oxygenised water.

Metallurgical Applications.—The usefulness of the pure oxygen in conjunction with hydrogen, for producing the intensely-hot oxy-hydrogen flame, is illustrated in a variety of interesting operations and specimens exhibited.

Light.—The Drummond light is shown, as produced with a flame yielded by pure oxygen and hydrogen, and it is suggested that this beautiful light would become more generally applicable and useful were pure oxygen so cheaply and easily obtained as the exhibitors believe their process would enable it to be.

Ozone.—It is pointed out by the exhibitors that the production of pure oxygen on the large scale would probably soon lead to the attention of scientific and practical men being drawn to the preparation of ozone by the action of the electric current on oxygen, or otherwise, and to its employment in the medical treatment of certain complaints.

GEORGE BARTH & CO., LONDON (*Group XIV. No.* 1437).

Exhibit (1) apparatus for the administration of nitrous oxide gas in combination with ether ; (2)

portable apparatus for the inhalation of oxygen or other gases in combination with atmospheric air.

John Orchard, London (*Group XIV. No.* 1432),

Shows specimens of compressed and liquefied gases, valves and bottles.

Mackey, Mackey & Co., London (*Group XIV. No.* 1446),

Show a fine set of specimens of neutral soluble salts of cerium for medicinal purposes, comprising the following :—Ammonio-citrate of cerium, ammonio-tartrate of cerium, potassio- and sodio-citrates and tartrates of cerium, lactates of cerium.

The mineral used as the source of cerium is cerite, which is chiefly composed of silicates of cerium, lanthanum and didymium, the oxide of cerium on the average present being 39 per cent.

The first introduction of cerium as a therapeutic agent appears to be due to Sir James Simpson, who recommended cerium oxalate as a specific against obstinate cases of vomiting, and its good effects Simpson found not to be confined to the forms of vomiting which depend on the sympathetic derangement of the stomach caused by changes functional or pathological, in the uterus or other organs, but which are manifested also in those forms of the complaint which are due to different morbid conditions of the stomach itself. He expressed the opinion that other salts of cerium would answer as well as the oxalate ; but this salt was the one then most easily procurable. "The action of cerium on the stomach seems to be that of a sedative tonic, resembling, in some degree, the action of salts of silver or bismuth, and I have" (writes Simpson) "seen it successful in curing the most obstinate cases of vomiting. The effect is sometimes instantaneous, sometimes the vomiting ceases after a few doses, sometimes not until the remedy has been persevered with for several days."

The "Liquor Ceric cum Bismutho," a specimen of which is shown, is said to be a very powerful specific at present recommended for the prevention or reduction of vomiting.

Howards & Sons, Stratford, E. (*Group XIV. No.* 1467).

Alkaloids.—This firm exhibits exceedingly fine specimens of cinchona barks and alkaloids ; also an interesting variety of salts of certain organic acids and alkaloids useful in pharmacy. The samples of bark shown illustrate the great change which the introduction of cultivated bark has brought about in the quinine industry. In 1862 South America was looked to as the source of cinchona bark as a matter of course. At the present time, however, the East India barks are almost entirely worked. There still remains a great deal to be done in choosing the varieties, and in cultivating the bark to the best advantage. Ten and twelve per cent. of quinine sulphate are not unusual yields from picked trees, and there is no reason to think that the maximum is reached ; while the renewing process, which was discovered by Mr. McIvor, has enabled the growers of *Cinchona Succirubra* to double the yield of quinine. The alkaloids exhibited by this firm are novel as to purity. The various alkaloids found in commerce are now completely separated, and ought to be obtained of a degree of purity far greater than was the case formerly. Amongst the salts of quinine shown, the following immediately strike the eye of the chemist :—*Chlorate of quinine, salicylate of quinine, iodide of quinine, acetate, and valerianate of quinine.*

Interesting specimens are shown of crude China and Japan camphors, the Japanese article, as regards whiteness and apparent purity, decidedly bearing the palm.

Samples of camphor cakes are also exhibited. They consist of compressed camphor, and the effect of the compression is to produce a mass resembling in its structure and appearance glacier ice, the process furnishing an example of true regelation.

Iodoform.—Till within the last few years iodoform was merely a chemical curiosity, but now it is become of great value in surgery, and is used in enormous quantities, and with most remarkable results.

A beautifully-crystallised specimen of iodoform is exhibited by Messrs. Howard.

May & Baker, Battersea, S.W. (*Group XIV. No.* 1467),

Exhibit some of their finer chemicals. Gallic and tannic acids are shown, with a specimen of pyrogallol in beautiful white crystals. Benzoic acid prepared from "gum benzoin," with a series of benzoätes, amongst which a finely-crystallised specimen of benzoate of ammonium ($NH_4C_7H_5O_2$) is worthy of notice. The mercurial preparations form a complete and exceedingly well-crystallised set, and the bismuth compounds are crowned by a beautifully-crystallised specimen of the metal.

Messrs. May & Baker also show specimens of the recent pharmaceutical novelty—viz., true oleates obtained by precipitation, which, besides possessing the advantage of reliable composition, are probably in a form most convenient for the production of effective ointments. These metallic oleates are variously-coloured pasty masses. A specimen of pure oleic acid is also shown. The "Sublimed Transparent Tablet Camphor" exhibited by this firm appears in all shapes and sizes. Some of these tablets, indeed, bear considerable resemblance to Iceland spar, and by a modification of the process, indelible lines and marks are produced throughout the blocks, taking the form of monograms, designs, etc. A mould or "template" in sections is shown to illustrate the patented method of "working" up the metallic bomblows used in subliming into the ring form, the older form of sublimation being illustrated by a small ring or "bell" of camphor and "bomblow."

Hopkin & Williams, London (*Group XIV. No.* 1467),

Exhibit specimens of their manufacture of fine chemicals.

A series of samples of metallic oleates is shown, almost all of them being in the dry form. The series has certainly the appearance of a remarkably fine set of preparations.

The copper sulphate is purified by a novel process, and is perfectly pure.

Its entire freedom from iron is easily proved by supersaturating a solution of some of the salt in water with ammonia, and allowing it to stand for some hours, when any iron present will be deposited.

The specimens of bichromate of ammonia and sulphocarbonate of zinc represent preparations largely made by this firm.

By many medical men the salicylic acid, which is the natural product obtained from the oil of wintergreen (*Gaultheria Procumbens*) is considered superior to that obtained synthetically and artificially from carbolic acid, which may possibly not always be quite pure. A specimen of this natural salicylic acid in very fine crystals is exhibited, and a series of salicylates all prepared from the natural acid. It is needless perhaps to remark that the salicylates usually found in commerce are now prepared from the synthesized salicylic acid. The following is a list

of the specimens shown by Messrs. Hopkins & Williams:—

Potassium chromate (pure).	Sodium chlorate (pure).
,, borotartrate.	Calcium benzoate.
Camphor monobromide.	Quinine hydriodate (soluble).
Silver oleate.	Chromic anhydride.
Copper ,,	Lead iodide (crystallised).
Iron ,,	Chromium chloride (sublim'd)
Zinc ,,	Cantharidine.
Cadmium ,,	Coccaine (pure)
Aluminium ,,	Acconitine (pure, English).
Mercury ,,	Mercuric iodide (biniodide), sublimed.
Nickel ,,	Sodium nitroprusside.
Tin ,,	Ammonium bichromate.
Arsenic bromide.	,, chromate.
Anthraquinone (sublimed).	Urea, pure.
Alizarin, artific. (sublimed).	Theine.
Zirconia (pure).	Salicylic acid (natural).
Barium nitrate (pure).	Sodium salicylate (natural).
Iron (ammonia) alum (pure).	Quinine ,, (,,).
Zinc sulphocarbolate.	Cinchonidine ,, (,,).
Copper sulphate (pure)	

Robert H. Davis, Chemist to the Society of Apothecaries, Apothecaries' Hall, London (*Group XIV. No.* 1467),

Exhibits a collection of chemical and pharmaceutical preparations illustrative of the employment of this class of agents by the medical profession of this country. The specimens include some typical preparations of pharmacy which have long been in use, such as tinctures and extracts, as well as the most of those more recently-introduced remedies such as iodoform, kairine, antipyrine, paraldehyde, etc., that must at present be considered to be upon their trial, since they have not yet received the seal of full official approval, granted by a place in the National Pharmacopœia.

The Washington Chemical Co., Durham (*Group XIV. No.* 1467),

Shows specimens illustrating its manufacture of fine chemicals.

W. Lascelles-Scott, Essex (*Group XIV. No.* 1469).

Diagrams showing improvements in apparatus for the preparations of pharmaceutical and other extracts.

Thomas Christy & Co., London (*Group XIV. No.* 1467),

Show specimens of their fine chemicals and pharmaceutical preparations. The following is an account of some of the more interesting of these. *Doundaké Barks.*—Under this name several barks obtained from the West Coast of Africa have been examined in France. One of these is identical with the bark of a root coming from Siberia, and known as peach root; it is obtained from *Sarcocephalus Esculentus*, a plant belonging to the cinchona family. Messrs. Heckel and Schlagdenhauffen consider it capable of replacing cinchona bark as an astringent and febrifuge, and also regard the beautiful yellow colouring matter contained in the bark as worthy the attention of dyers. According to these authorities the Doundaké plant is found from 16° N. latitude to 5° S. latitude, from Senegambia to the Gaboon. The bark from Sierra Leone has a greyish smooth surface, cracked here and there, and presenting small hard excrescences of a darker colour. When older the bark becomes blackish, the cracks multiply, and the epidermis falls off as a reddish dust. The interior of the bark is of an ochrey yellow, and is situated longitudinally. The bark has a bitter taste, and when chewed gives a yellow tinge to the saliva. The bark from Rio Nunez is similar, but has no blackish excrescences, and the internal surface is darker yellow. The bitter taste is due to two nitrogenous principles of a resinoid character, differing in their solubility in alcohol, and having the respective formulæ $C_{28}H_{19}NO_{13}$ and $C_{10}H_{16}NO_{9}$. The bark also contains a tasteless crystalline principle soluble in caustic potash, and also glucose and traces of tannin. It appears that another variety of Doundaké was examined by MM. Bochefontaine, Féris, and Marcus, and found to contain a poisonous principle, and the bark of this poisonous species was of an *orange red colour*. To prevent confusion with the tonic and febrifuge bark, it would be best doubtless to retain for the latter the name "African Peach Root."

Gouania Domingensis.—This plant contains a principle which renders it most valuable for the manufacture of tooth preparations of a similar kind to floriline. A specially-useful gargle has been prepared from it. In the United States the stem of the plant is cut into pieces about six inches long, and each piece is bruised at one end and used as a tooth-brush. The effect is said to be very strengthening to the gums, as well as cleansing to the teeth.

Gutta-Percha.—A specimen is shown of a new species from a tree, the botanical name of which has not yet been ascertained. According to Sir Joseph Hooker (Kew Report, 1881, p. 38), the time cannot be far distant when the natural sources of gutta-percha will be definitely used up. It is therefore most important that the gutta-percha tree should be planted in colonies where it will grow, as it will doubtless in the future prove a source of considerable profit. Unfortunately the best gutta-percha tree is of very slow growth, and it has become so rare that it is difficult to obtain seeds. There are, however, other trees of more rapid growth which yield gutta, and which are worthy of attention. One of these which yields gutta-lundek has recently been identified by Dr. Trimen as *Payena Leerii*. The tree grows in swampy places near the coast, even where the water is salt, and land of this character can therefore be turned to account by the planting of this valuable tree. As yet no means have been discovered of obtaining the whole of the gutta from the bark, indeed it is calculated that only one-thirtieth part of the juice contained in the bark is obtained by incision. It has been proposed, however, to strip off alternate layers of bark, pound them and boil with water. It is thought that in this way the whole gum might be obtained. Various kinds and qualities of gutta-percha are afforded by different sapotaceous trees, but the pure red gutta-percha of Borneo, which is considered to give the best quality, is yielded by *Dichopsis Gutta*. This species is characterised by trees of red and rough stems, generally found among old jungle on the hill sides, growing to a height of 100 to 150 feet, with a diameter varying up to 3 feet. The natives on finding a tree, say 12 inches in diameter, proceed as follows:—They fell it, cut off the top, and ring the bark at distances of about a foot. The sap gradually drains away for about two or three days, and is collected in any convenient vessels, such as leaves, cocoa-nut shells, etc., from which it is transferred to a pot and boiled with a little water for half-an-hour or so. The milk is boiled to prevent it from hardening on exposure to the air, as if allowed to do so it becomes comparatively valueless. It is very difficult to estimate the yield, as the quantity varies so much according to the size of the tree and the time of the year, the flow of sap being greatest when the tree is producing most leaves. A small tree will yield generally 33¼lb., while the largest may yield even as much as 100lb. The red gutta is often mixed with the inferior product of other species. Another species, *Dichopsis Macrophylla*, yields an inferior gutta of white colour. It is of smaller growth than the *Dichopsis Gutta*, being 50 to 60 feet high, and differing slightly in the foliage. The gutta beds are being gradually exterminated, as they are of

slow growth, and the natives do not take the trouble to plant seeds or cuttings. *It becomes most important, therefore, that the tree should be planted in suitable localities in the British colonies, and it is moreover highly probable that by proper cultivation and care the variation in the yields of gum could be prevented by the attainment of a tolerably uniform maximum yield.*

Hydrocotyle Asiatica.—The leaves of this plant are usually administered in the form of a powder, which is obtained by removing the stalks from the fresh leaves and then drying the latter in the shade in the open air. Thirty pounds of fresh leaves yield about three or four pounds of the powder. Hydrocotyle contains a peculiar principle called "vellarin," which is an oily liquid, not volatile, and possessing the odour and taste of the herb. It is recommended as a poultice to stimulate ulcerated surfaces to healthy action, as snuff in cases of ozœna, and as an ointment mixed with lard in cases of skin disease. It is also well spoken of when used in cases of secondary syphilis, leprosy, etc.

Jatropha Curcas.—This is a seed, the oil of which should certainly be experimented with by soap makers, as well as by the medical profession. The oil possesses properties resembling those of castor oil, but not the disagreeable smell of the latter. It has an agreeable almond-like taste, and 30 to 60 drops act as an efficient purgative. The plant forms an excellent hedge, as cattle will not eat the leaves, and cuttings rapidly take root. It is indigenous to tropical America, but is found almost everywhere in warm climates. The seeds are regularly exported to Portugal from the Cape de Verde Islands to the extent of about 350,000 bushels annually, for the expression of the oil. Before expression the seeds are slightly roasted and crushed, when the shells are easily removed. 1000lb. of seed give 640lb. of kernels yielding about 260lb. of oil. From Portugal the oil appears to find its way to France, *probably for the manufacture of transparent soap.* The oil could be obtained in any quantity for manufacturing purposes. The juice of the fresh plant is a valuable hæmostatic, and is said to rapidly coagulate the blood even in an artery, so that it can be probably used for the cure of aneurism.

Kava-Kava.—This extract has just recently been suggested to the exhibitors as a rapid and certain cure for gout and gonorrhœa, and is now being experimented with in the London Hospitals. It is also claimed for it by a gentleman, who resided for some time in Fiji, that it has the power of adding the quality known as "age to the rawest whisky" very rapidly. This statement is one worthy of experimental investigation.

Kola Nuts and Paste.—Kola nuts are now coming largely into use for a variety of purposes, the most important form being that of the paste, a sample of which is shown. This paste, which could not easily be distinguished from ordinary cocoa-paste, contains a little over 2 per cent. of caffeine, and forms therefore a stimulating food of great value. It is important to remember that the paste shown is made from the kola nut without any mixture whatever. If this paste, which is five times as strong as cocoa, be added to the lowest quality of the article, it raises this quality so as to render it equal to that of the best Caraccas cocoa. Owing to the abundance of caffeine in this paste, it is said to be of the greatest service in counteracting the effects of drink, by restoring clearness to the head. It is said that after chewing the Kola nut on the West Coast of Africa for the purpose just named, a drunkard cannot return to stimulants for some days without feeling nausea. If this be so, a judiciously-prescribed diet of kola nut would suggest itself from the preceding, as possibly offering a practical and valuable solution of a difficult problem for a considerable percentage of the inhabitants of the British Isles!

Menthol Cones are shown in a variety of patterns to suit all markets, and are made of pure menthol crystals without admixture. The best menthol is the Japanese from the plant *Mentha Arvensis var. Piperascens*, and it contains more of the oil of peppermint than any other varieties.

Papaine forms an important solvent, and is obtained both in the form of a white powder and of a dried juice, and is known commercially as Papaine-Christy. It is made specially from the fresh milk of the fruit of *Carica Papaya* for Mr. Christy by a chemist residing on the Papaw plantations. Papaine has been proved by Prof. Finkler, of Bonn, to be capable of dissolving in pure water 1000 times its weight of fresh fibrin. Finkler states that it dissolves very rapidly the membranes of diphtheria and croup, and that not a single patient he has treated in the University Hospital or in private practice has died, but that all have recovered. In every case the membrane was dissolved by painting it with papaine about five times a-day. He further adds that since "papaine can be applied with salicylic acid, which increases its action, he maintains that there is no other drug in existence equally powerful for the purpose stated." Finkler found that when the membrane was dissolved the fever disappeared. According to the *Berliner Klinische Wochenschrift*, Dr. Schoffer, who has tried most of the remedies recommended for diphtheria, has obtained the best results with papaine. Last summer (1884) he treated 47 cases of this deadly complaint with a 5 per cent. solution of it. He begins the treatment as soon as possible, and orders the patches to be painted every five or ten minutes; in a few hours the membranes are said to be removed, and at the same time the fever disappears.

Pine or Spruce Extract (Christy). This has been tried in a London hospital, and proved to be of the utmost service in kidney and bladder diseases.

Pine Extract for Baths, is an extract made from the fir or pine. It is dissolved in boiling water, and the solution is added to the bath-water. The medicinal and strengthening properties are, it is said, very beneficial, especially for children, and the aroma is extremely pleasant.

Cinchonamine.—This is likely, it is stated, to become a very important drug, both therapeutically and chemically.

Cuprea bark has been imported in large quantities into London for the last few years. It consists of several varieties, two of which have a marked difference in their chemical composition. The one, *Remijia Pedunculata* contains quinine and homoquinine, the other, *Remijia Pardieana*, contains little or no quinine, but an alkaloid named cinchonamine by its discoverer, M. Arnaud. (*Compt. Rend.* xcvii. 174.) Cinchonamine combines readily with acids, forming salts which crystallise well, are only slightly soluble in water, especially in presence of excess of acid. They are more soluble in hot alcohol. The property possessed by the anhydrous hydrochloride of crystallising very readily, is used as a means of separating the alkaloid easily from the other alkaloids of the bark. The nitrate also crystallises with extreme facility, and is almost insoluble in acidulated water. The crystals are well-defined and easily recognisable. It is proposed to turn this property to account analytically, by using cinchonamine as a test for nitrates. Iodides must, however, be first removed by addition of silver acetate. For testing Arnaud prefers to use the hydrochloride.

He thinks the method may be very useful in solving certain problems connected with vegetable physiology, such as the formation of nitrates in plant tissue and their circulation and metamorphosis in different parts of the plant. (See *Pharm. Journ.* [3], xiv. 162.)

Arnold Spiller (*Group XXIX. No.* 2254)

Exhibits photographs developed by means of hydroxylamine and various alkalis. A gelatino-bromide film is prepared, also gelatino-chloride of silver transparencies, developed with hydroxylamine and various alkalis.

A prize of considerable value has already been offered in Mülhausen, in Alsace, for a good commercial method for preparing hydroxylamine, and this application to photography by Mr. Spiller would add further value to such a discovery.

Eugene Rimmel, London (*Group XIV. No.* 1436),

Exhibits (1) Working model of Rimmel's Myrogene, a new apparatus for extracting the perfume from fresh flowers; (2) Specimens of new sanitary perfumery; (3) Toilet articles.

The Myrogene consists of three bodies (Fig. 1) A, B and C, fitting into each other, and forming a column which rests upon three feet D. The upper body is a reservoir to contain the prepared alcohol, with a cover on the top, and a bottom pierced with small

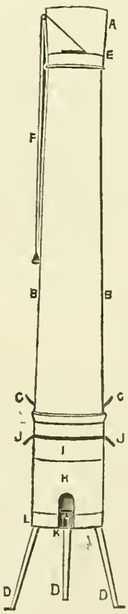


Fig. 1.

holes, above which is a valve E, set in motion by a string F, worked on a pulley. The body B is a long case through which the alcoholic shower passes without being exposed to evaporation. At the lower extremity are two external catches GG. Inside the body CC slides a cylinder H, carrying on the top a movable sieve I to receive the flowers, and at the bottom a tap, through which the extract is drawn off. The cylinder H fastens on to the catches G by means of hinged hooks J, which are turned down when the sieve requires removing or replacing. In order to make the apparatus more secure, it is

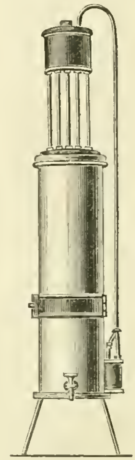


Fig. 2.

advisable to erect it in the corner of a room, and make it fast to the walls by means of a piece of wire tied round the body B. The model shown is a nickel-plated and elegant piece of apparatus (see Fig. 2).

Mode of Operation.—Unfasten the hooks J (Fig. 1), and let the cylinder H slide down; take out the sieve I, and fill it with freshly-gathered flowers, carefully picked, removing all the green and leaving only the petals, pistils and calyx. Replace the sieve in the cylinder, raise it up and refasten it to the catches G. Fill the upper reservoir A with prepared alcohol, pull the string F, and as soon as the liquid has passed through the flowers, draw it off through the tap K, and repass it twice in the same way over the same flowers. Let the sieve be again filled with fresh flowers, and repeat the operation until the alcohol is sufficiently impregnated. The usual proportion for one pound of flowers divided into three or four portions, is one pint of alcohol, but it is impossible to lay down a general rule, as the quantity of flowers necessary to produce a strong extract naturally depends upon the intensity of their aroma, which also varies according to the climate. Thus cassie and jonquil yield a powerful perfume with a single operation, whilst violets and mignonette must undergo at least four. Flowers that have been operated upon are drained in a covered filter to lessen the loss of absorptiou; they may afterwards be submitted to moderate pressure, but the extract then drawn off is of inferior quality. All flowers possessing odour can be successfully treated by this process, but alcohol alone does not suffice to fix their aroma in a permanent manner; it requires for that to be mixed with another ingredient, in the proportion of one ounce of the latter to the gallon of ordinary alcohol, in order to give the prepared alcohol. This ingredient, or "chemical basis," as it is termed by the exhibitor, is specially prepared and sold by him and his agents.

EXPLOSIVES.

NOBEL'S EXPLOSIVES CO., LIMITED, GLASGOW (*Group XXV. No.* 1899).

Nitroglycerine has been successfully applied by Capt. Alfred Nobel to explosive purposes as effected by detonation, and to this end the method of manufacture involves important details. Specimens illustrating (1) dynamite and blasting glycerine, (2) detonators, and (3) electric fuses, are shown, the products of the above well-known firm.

THE SCHULTZE GUNPOWDER CO., LIMITED (*Group XXV. No.* 1900).

Specimens are shown of the Schultze's patent smokeless gunpowder, made from wood. It is a perfectly white substance, in a granulated form. Wood is rendered explosive by being nitrated, and the product is then granulated. Cartridges charged with it are shown.

ANALYTICAL CHEMISTRY.

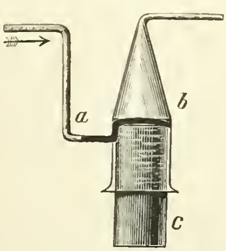
ARNOLD EILOART, LONDON (*Group XIV. No.* 1467),

Exhibit specimens of patent airtight stopcocks.

These stopcocks were devised principally to prevent the possibility of leakage occurring in the manipulation of gases in chemical experiments. They are simply ordinary stopcocks made airtight by means of a "liquid joint" arrangement, so contrived that the taps occupy no more space than the ordinary ones.

In the earliest form, the case of the tap was cupped at the top and closed at the bottom to receive liquid. But the cheapest and best way of making the chambers for liquid is to form annular grooves in the plug, one above and one below the bore. The case into which the plug fits is then of the common form. This tap can be used to close either a vertical or a horizontal tube. Leakage along the tube to be closed, round the plug, has still to be guarded against. For this, taps are shown the plugs of which have straight grooves at right angles to the two ring-grooves and joining them. (The plug may then be turned in only one direction to close the tube, and back to open it.) It might be thought that in trying to fill these grooves, entirely closed in by glass as they appear to be, when the plug is in position, a practical difficulty must occur; but this is not so.

The most interesting exhibit is a little arrangement which may in many cases be used instead of a stopcock, and is about one-fifth the cost of one. This is a T-piece arrangement, of which one branch



is a tube of half-inch bore into which a smaller tube *a* is fused at right angles; half-an-inch below the joint the wide tube is open; half-an-inch above the joint it begins to taper off (at *b*). An indiarubber plug *c*, not tapering, and covered with a layer of mercury, is pushed upwards past the joint, and so completely shuts off the passage of gas from the side tube, into which also some mercury flows. The passage is opened by slightly lowering the plug. Thus the gas is never in contact with the rubber, but only with glass and mercury.

ADDENDUM TO REPORT OF THE EXHIBIT OF MESSRS. CHAPMAN & MESSEL. (SEE P. 520.)

MANUFACTURE OF ANHYDROUS SULPHURIC ACID.

Dr. Messel made his specific gravity determinations at the temperature of 80° F., where all the anhydrides are liquid, though afterwards calculating the results of these to specific gravities at 60° F., when some of the anhydrides become crystallised. It was thought that the readers of this report would be interested in comparing the actual table of results obtained at 80° F., and Dr. Messel has kindly furnished these numbers. The complete table should therefore appear as follows:—

Specimens.	Percentages of SO_3	Specific Gravities.	
		At 80° F. (26·6° C.)	Calculated to 60° F. (15·5° C.)
——	8·3	1·812	1·852
Liquid	30·0	1·930	1·940
Crystalline mass resembling nitre	40·0	1·956	1·970
	44·5	1·961	1·975
	46·2	1·963	1·977
——	59·4	1·980	1·991
Liquid	60·8	1·992	2·006
	65·0	1·992	2·006
	69·4	2·002	2·016
Crystallised	72·8	*1·984*	*1·988*
	80·0	*1·959*	*1·973*
	82·0	*1·953*	*1·967*

Communications.

ON THE ESTIMATION OF SULPHUR IN PYRITES,

BY JOHN CLARK, PH.D.

IN the July number of the *Journal of the Society of Chemical Industry* (page 449), Prof. G. Lunge makes some remarks on my process for the estimation of sulphur in pyrites, and states, as his objections, that it estimates the sulphur in galena, and the sulphates of lime and baryta, whilst in the wet process nearly the whole of the useless sulphur is left behind in the insoluble; and I presume that in his opinion this is the cause of the difference between the wet and the dry process. Now, the samples of pyrites upon which I operated contained no weighable quantity of sulphate of barium, less than one per cent. of lead, and from ·1 to ·2 per cent. of lime. In fact, they were typical samples of shipments of Spanish pyrites. I admit that the sulphur in the galena and sulphate of lime is estimated by my process, but it is also estimated by the modification of the wet process employed by the chemists of the Tharsis Company and by Mr. Tatlock, with which alone my process has

been compared. The modification to which I have referred consists in treating the pyrites (twenty grains) with aqua regia, and after evaporating to dryness, dissolving in one ounce of hydrochloric acid, filtering, and making up with the washings to a bulk of thirty ounces. After adding the proper quantity of chloride of barium and allowing the precipitate to stand, the clear liquid is decanted and the precipitate washed, first with thirty ounces of hot water containing 300 measured grains of hydrochloric acid, and finally with thirty ounces of pure water. I think it will readily be admitted that with such quantities of acid and water, the whole of the lead and lime usually present in Spanish pyrites will be found in the solution; so that the question at issue between my process and the modification of the wet process is, in my opinion at least, really limited to the solubility of the sulphate of barium in hydrochloric acid, and, whether rightly or wrongly, it is to this cause alone that I attribute the difference in the results. Prof. Lunge may, perhaps, consider that this modification of the wet process is inferior to his own, and quite as objectionable as the dry process, but I would point out, what he has already remarked, that this modification gives very concordant results; whereas, even in the hands of such skilled analysts as the assistants of Fresenius, the wet process, as described by Prof. Lunge, cannot be relied upon to within half a per cent. of sulphur.

THE MANUFACTURE OF PHOSPHORIC ACID FROM PHOSPHORUS.—A BRIEF REVIEW OF THE METHODS IN USE AND A DESCRIPTION OF A NEW PLAN FOR THE PRODUCTION BY THE SLOW OXIDATION OF PHOSPHORUS IN MOIST AIR.

BY ADOLPH SOMMER,

University of California, Berkeley, Cal., U.S.A.

THE author commences by a critical description with details of the various methods of manufacturing phosphoric acid from phosphorus itself, as distinguished from its manufacture from bone earth or glacial phosphoric acid. Eight processes are discussed, viz:

(*a*) oxidation by burning in air;
(*b*) ,, by strong HNO_3 at a low temperature;
(*c*) ,, by dilute HNO_3 at a high temperature;
(*d*) ,, by Br and water;
(*e*) ,, by I and water;
(*f*) ,, by dilute HNO_3 and a little Br;
(*g*) ,, ,, ,, ,, ,, ,, I;
(*h*) ,, ,, ,, ,, ,, ,, I and Br.

The conclusions of the author as to these processes are as follows:—

(*a*) When phosphorus is burnt in air on a manufacturing scale the operation is attended with danger, and the products of combustion are variable. At the same time this is the only possible process if one desire to obtain phosphoric anhydride.

(*b*) When strong HNO_3 is used, as recommended by Von Schroetter, the operation is attended with danger, unless the phosphorus be in the amorphous form, which materially adds to the cost.

(*c*) When excess of dilute HNO_3 at a high temperature is employed, subsequent extraction of the arsenic (a body invariably present) is rendered complex. This method is recommended by the Pharmacopœias.

(*d*) When excess of Br and water is used as recommended by Wagner (*Deut. Ind.* 1875, p. 403), more HBr is formed than H_3PO_4. It is also costly and dangerous. (See this Journal, 1884, p. 20.)

(*e*) The same objections apply to the use of I and water unless iodides are made a collateral object. (See Pettenkofer, in *Dingl. J.* 181, p. 218; and *Ann. der Chem. u. Phys.* 138, p. 51.)

(*f*) When dilute HNO_3, with a little Br as a carrier of oxygen, is employed, action ceases when the HNO_3 becomes very dilute, and heating tends to dissipate Br.

(*g*) The use of I in the place of Br as in (*f*) has the advantage that I is less volatile, but in this case heating tends to convert the P into the amorphous variety.

(*h*) The use of a mixture of Br and I in the place of the single element as in (*f*) and (*g*) with dilute HNO_3 has been attended with fairly good results. (See Markoe in *Am. Jnl. Pharm.* 1875.)

All these methods, except (*a*), have one great objection in common:—viz., that the inevitable excess of oxidising agent, whether HNO_3, Br, or I, has to be removed before the arsenic which is invariably present can be removed by SH_2, or reduced into the metallic state.

The author therefore gives his preference to slow oxidation at a low temperature by moist air, in which process there is no excess of oxidising bodies to retard the removal of the arsenic.

Wenzell (*Proc. Am. Pharm. Assoc.* 1882, p. 556) was the first to pratically apply this property of phosphorus. As early as 1796, Pelletier (*Urés Dict. Chem.* 1828, p. 67) had devised a process for the manufacture of "phosphatic acid" by the slow oxidation of cylinders of phosphorus disposed each in a glass tube drawn out at one end to a fine orifice. These glass tubes, to the number of 30 or 40, were placed in a funnel the beak of which was passed into a bottle standing in a plate of water, and the whole was covered with a bell-glass with inlet and outlet for a small current of air. The phosphorus slowly oxidised, and the product deliquesced and dripped into the bottle. This "phosphatic acid" was proved to be a mixture of phosphorous and phosphoric acids by Thenard, Dulong and Leverrier (*Ann. Chem. u. Phys.* 67, 278), but the simultaneous formation of ozone, peroxide of hydrogen, and ammonium nitrate was only recently observed, prominently by Schönbein and Leeds (*Journ. Am. Chem. Soc.* iii. 6). Buchholz (*Beitr. zur Erweit. der Chem.* i. 63) first recommended the production of H_3PO_4 from this body by heating with HNO_3. A. Vogel (*Gmelin*, vol. ii. Lond. 1849, p. 121) and Liebig (*Ib.* p. 128) proposed methods for the elimination of the arsenic, invariably present.

The author first adopted a modified form of the process of Wenzell (*v.s.*). In a shallow trough fitted with a porous cover were placed horizontally cylinders of phosphorus supported on strips of plate glass, and as much distilled water as would suffice to leave about one-eighth of an inch of the phosphorus above water. In three or four days the phosphorus was found to be eaten away down the surface of the water. Portions of the liquid were then successively withdrawn until the whole of the phosphorus was dissolved. In order to reduce the arsenious acid to metallic arsenic, the acid liquid thus formed was heated in a dish to 190° C., at which temperature bubbles of hydrogen phosphide were evolved, marking the completion of the operation. The reaction is expressed by the following equations:—

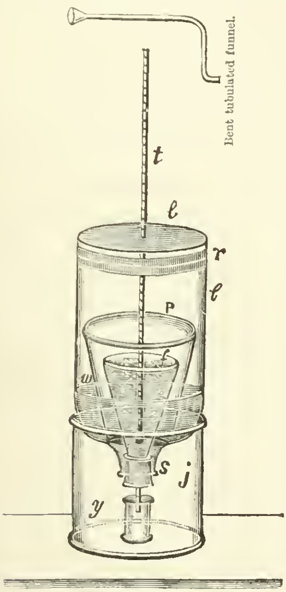
(*a*) $4H_3PO_3 = 3H_3PO_4 + H_3P.$
(*b*) $3H_3PO_3 + 2H_3AsO_3 = 3OH_2 + 3H_3PO_4 + AsO_2.$

After cooling the liquid was filtered and any further traces of phosphorous acid were oxidised by HNO_3 or Br.

The tediousness of the above induced the author to devise a new process. A glass jar, in which rested

a funnel, was placed in a tin can fitted with a cover through which passed a thermometer, the bulb of which descended into the funnel. By an arrangement of holes in the cover a regulated supply of air was admitted, and the inside of the can was lined with cloth, the capillary action of which served to convey sufficient moisture to the air of the can from a measured quantity of water, proportionate to the quantity of phosphorus to be oxidised, placed in the bottom. The cylinders of phosphorus were disposed in the funnel and the bulb of the thermometer buried among them, an atmosphere of CO_2 being used to ensure safety during this part of the operation. According as the temperature ranged above or below 35° C., less or more air was admitted until the temperature remained constant, in which state the oxidation was left to complete itself. When finished, if properly performed, the phosphorus was found to have completely disappeared, and the jar contained a mixture of phosphorous and phosphoric acids which were treated as above described.

For the construction of a continuous and transparent oxidising chamber, preferably one of white and very clear glass is selected, and the bottom very carefully cut off. This is best done by means of

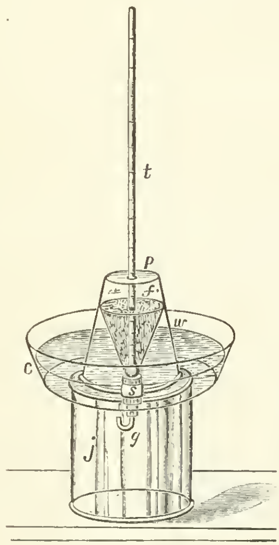


(*f*) Funnel filled with P.
(*t*) Thermometer.
(*p*) Flower pot.
(*j*) Glass jar.
(*w*) Water.
(*b*) Bottle (inverted).
(*s*) Perforated stopper.
(*y*) Glass cylinder.
(*r*) Strip of paper glued over the cut in the bottle.

specially-prepared carbon pencils made of powdered charcoal, saltpetre and tragacanth. A common unglazed flower-pot, the largest that will go into the bottle, is inserted into the open bottle so that the bottom of the flower-pot is directly over and in contact with the neck of the bottle. A funnel, the conical part of which is at least an inch shorter than the flower-pot, is then inserted in such a way that the funnel-tube passes through the bottom of the flower-pot and the neck of the bottle. Into the neck of the bottle the funnel-tube is securely fastened by means of a perforated paraffined cork, which must be water-tight.

This portion of the apparatus is then placed, neck downward, over a large glass jar in which stands a narrow cylinder filled with water. The cylinder is to be in such a position that the end of the funnel-tube will dip into the liquid contained in the cylinder.

Through the centre of the bottom, which was cut off the bottle, a hole of at least $\frac{5}{8}$ of an inch in diameter is drilled. The bottom is then put into its original position on the bottle and fastened by gluing strips of paper over the joint. The hole in the bottom is loosely closed by a cork through which passes a thermometer. When the oxidising chamber is thus completed the cork is removed, and by means of a funnel, having a long bent tube, water poured into the space between the walls of the bottle and the flower-pot, until its level is within a short distance from the upper edge of the funnel within the flower-pot. Then a tube connected with a carbonic acid generator is inserted into the hole and carbonic



(*f*) Funnel filled with P.
(*t*) Thermometer.
(*p*) Flower pot.
(*j*) Gass jar.
(*w*) Water.
(*g*) Bent glass tube.
(*s*) Perforated stopper
(*c*) Tin pan,

acid gas passed into the oxidising chamber. When the air within has been entirely displaced by the gas, sticks of phosphorus are dropped through the hole into the funnel until the latter is nearly filled. The thermometer and cork, in the sides of which a few notches have been cut, are then placed into position and the apparatus allowed to stand for about twenty-four hours. If at the end of this time the temperature of the P is below 35° C., a little more ventilation may be given by enlarging the notches in the cork.

The flower-pot in this apparatus performs the same function as is fulfilled in the former by the cloth lining—namely, that of absorbing the water and moistening the air. The acid which is formed runs first into the small cylinder and thence into the glass jar which serves as receiver. Whenever it is seen that that the phosphorus is nearly consumed or the water evaporated, a fresh supply is added through the hole without taking the apparatus apart.

A still simpler form of a continuous oxidising chamber I have constructed in the following manner: Through the bottom of a tin pan a hole of about 1in. in diameter is cut and a tube of tinned iron about ½in. long soldered into it. By means of a perforated cork a funnel is fastened into this hole so that the funnel-tube passes through the bottom, while the body of the funnel is inside of the tin pan. Into the end of the funnel-tube is inserted and fastened by a bit of rubber-tubing, a glass tube bent in a half-circle. A common unglazed flower-pot is inverted over the body of the funnel and a cork with a thermometer inserted into the hole, which is in the bottom of the flower-pot. The whole apparatus is then placed over a glass jar and some water poured into the tin pan. After the pouring of a few drops of water into the funnel, whereby the bend of the glass tube is closed against a downward escape of gas, the filling of the apparatus with carbonic acid and phosphorus is proceeded with in the same manner as has been mentioned under the description of the previous apparatus. When a very large quantity of phosphoric acid has to be made, a number of funnels may be fastened into the bottom of a wooden water tank, and each of them provided, as above described, with a bent glass tube, glass receiver and flower-pot.

The rate at which the phosphorus is oxidised by my method is a comparatively slow one. In an apparatus of style 1, in which the temperature was kept on an average 11° higher than that of the surrounding air, and the phosphorus, which was in the form of a solid cake of nearly 5in. in diameter, exposed a surface of about 18 square inches, the phosphorus was oxidised at the rate of about 10grm. a-day.

The difference between the inner and outer temperature does not seem to be affected to any extent by an increase or decrease of the prevailing temperature, for nearly 200 observations, which were taken at temperatures of the atmosphere ranging from 10° to 22° C., gave, while all other conditions remained equal, an almost constant difference.

The acid which collects in the receivers has a specific gravity of about 1·48, and is composed mainly of phosphorous and phosphoric acids in the proportion of 1 to 4, besides water. The exact composition differs with circumstances, and the determination of these circumstances may be the subject of some future paper.

The further treatment of this acid is in every respect the same as has already been described under Prof. Wenzell's process; but an acid prepared by my method has this great advantage over the one prepared by the former process, that it is already highly concentrated and requires very little evaporation before the arsenious acid is reduced.

THE OXIDATION OF PHOSPHOROUS ACID TO PHOSPHORIC ACID BY MEANS OF BROMINE.—BROMHYDRIC ACID A BY-PRODUCT.

BY ADOLPH SOMMER,

University of California, Berkeley, Cal., U.S.A.

The product of the slow aerial oxidation of phosphorus contains about one molecule of phosphorous acid to four molecules of phosphoric acid, and besides these some impurities, such as arsenious acid and others, mostly derived from the phosphorus. Of these impurities, the arsenious acid is particularly objectionable, and must be removed before the process of oxidising is entered upon. The removal of the arsenic, as has been described in my article on "The Manufacture of Phosphoric Acid from Phosphorus," is best effected by heating the acid to 190° C., subsequently diluting and filtering, after which the acid is ready to be oxidised.

Heretofore nitric acid has been the only substance employed for this purpose; but since the price of bromine has become so low (about thirty-five shillings per lb., in five-lb. bottles), that its cost is no longer prohibitory to its employment in the industries; and, furthermore, since the value of hydrobromic acid has been recognised both in analytical chemistry as well as in therapeutics, it may prove advantageous to substitute bromine for nitric acid in the oxidation of phosphorous to phosphoric acid.

From the equation—

$$\underset{82}{H_3PO_3} + \underset{159\cdot5}{Br_2} + \underset{18}{H_2O} = \underset{98}{H_3PO_4} + \underset{161\cdot5}{2HBr}$$

it will be seen that it requires nearly two parts of bromine to every one part of phosphorous acid. But the total acidity of the mixture of phosphorous and phosphoric acids, when of a sp. gr. of 1·48, is about sixty-six per cent., the composition of which approximates the proportion of one molecule (or twelve per cent.) H_3PO_3 to four molecules (or fifty-four per cent.) H_3PO_4. To convert the twelve per cent. of phosphorous acid into phosphoric acid would require theoretically $2 \times 12 = 24$ per cent. of Br. This result agrees very closely with that obtained in practice, when it was found that with an acid of a sp. gr. of about 1·48 there was needed a little over one-fourth of its weight of Br to complete its oxidation. This operation may be performed after the arsenic has been removed, either in a bottle containing the acid and Br by shaking this mixture from time to time (it must, however, not be shaken too often nor too much at one time, since a considerable amount of heat is liberated by the reaction, which may easily reach the boiling point of Bromine 63° C.), or it may be accomplished more rapidly by pouring the two substances into a retort, and keeping the mixture agitated by slowly passing air through it. In order to prevent any Bromine vapour, which is carried off by the air, from contaminating the atmosphere of the laboratory, I cause the air which escapes from the retort to pass through two bottles containing a solution of caustic potash. When the mixture is no longer decolourised on standing for about twelve hours, but retains a permanent orange colour, which is due to an excess of Br, the oxidation may be considered completed. The excess of Br is best removed by the addition of a small portion of the unoxidised mixture of acids, which has been reserved for this purpose.

There remains then only the separation of the bromhydric acid from the phosphoric acid, which is accomplished by a distillation in a retort from an oil bath. The precautions which have been pointed out in a previous article on the manufacture of bromhydric acid, in regard to its liability to decomposition by organic substances, have to be observed here. The mere insertion of the neck of the retort into a well-cooled receiver is sufficient. Neither luting nor rubber connections are necessary. The first portion which comes over consists principally of water (and Br, if this has not been removed in the manner stated above), and should be withdrawn before the bromhydric acid, which does not evaporate

to any great extent until a temperature of about 125° C. has been reached begins to distil. The distillation is continued until a temperature of about 180° C. is reached, when the fire is extinguished and the receiver with bromhydric acid detached. The retort and its contents are allowed to stand till cold, when a quantity of water equal to about one-third of the bulk of the contents is poured into the retort. Heat is then again applied and the distillation continued until the temperature in the retort has reached the same height as before. This second distillation serves to remove a portion of bromhydric acid which cannot be removed in the first distillation.

The phosphoric acid which forms the residue in the retort is a black syrupy liquid, which, however, after dilution with water, digestion with about half per cent of purified animal charcoal, and subsequent filtration through white filtering paper (best the brand known as "Chlorine Paper"), becomes perfectly colourless.

The black colour of the phosphoric acid is due to an organic impurity of the commercial Br, which, it is said, is derived from the luting of the stills, in the composition of which tar is used.

The bromhydric acid, which has distilled over, requires to be redistilled before it can be considered sufficiently pure for pharmaceutical purposes.

If the addition of Br is made to an acid, from which the arsenic has not been removed, the entire amount of arsenic will distil over with the bromhydric acid, while the phosphoric acid will be found free from arsenic.

Obituary.

WALTER WELDON, F.R.S.,

FORMERLY PRESIDENT OF THE SOCIETY OF CHEMICAL INDUSTRY.

Walter Weldon was the eldest son of a manufacturer at Loughborough, and was born on the 31st October, 1832. After having employed himself for some years in his father's works, he came to London, in the year 1854, and applied himself to literary pursuits. Of the labours and struggles of the following six years there is little to record. That they were sufficiently arduous and anxious we may well believe from our knowing little about them. They brought him assuredly neither name nor fame ; and a writer who, in six years, shall have acquired in no measureable degree a literary reputation, can scarcely be supposed to have discovered prosperity either. Moreover, before coming to London, he had married a young lady of his own age (he was in his twenty-second year), Miss Anne Cotton, of a Derbyshire family. This imprudence, however, was certainly the wisest thing he had yet done, or was perhaps ever to do. Of the sustainment derived in those early days of discouragement and difficulty from the courage, energy, and devotion of his wife, he ever loved to speak ; and it is only due to her memory,—for she too has passed away,—here to record it. During this period, he associated himself with the shareholders in a newspaper, proposed to be issued at this time under the title of *The Dial*, incorporated subsequently with the *Morning Star*, an influential Liberal London newspaper of that day. In furtherance of this project, he travelled through the provinces, making acquaintance with many of the country booksellers, who could not fail to be impressed by his energy, and frank and manly bearing. The connections thus established were soon to prove serviceable. He had, in his early years, experienced the need of some periodical, by which the scientific discoveries and movements of the day should be placed on record as they arose, in a popular form, and at a moderate price ; and to the establishment of such a publication he now addressed himself. It was originally designed to be a monthly "Register" of all facts and occurrences relating to the progress of Science. But he perceived, or was advised, that a periodical addressed solely to persons interested in science, to be published at the low price needful to reach those for whose benefit he proposed it, was unlikely, in that day, to obtain adequate public support ; and he therefore determined to associate with his records of scientific inventions and discoveries, a "register" also of the progress, from month to month, of Literature and Art. In order to give the country trade a personal interest in his project, he arranged that the publication should be issued by each bookseller in the country subscribing for a sufficient number of copies, *in his own name*. It was to be published monthly, and the price was sixpence. On the 1st August, 1860, appeared, in London, the first number of *Weldon's Register of Facts and Occurrences in Literature, Science, and Art*. Among some of the early papers in it, may be noticed one on Mr. Darwin's then recently published work on the "Origin of Species," written, I believe, by Mr. John Marshall. It was followed by others on "Building Stones, why they Decay;" "Recent Elementary Books on Geology," "Spectrum Analysis," "Philosophy of Earthquakes," "The Coal and Guano Dyes," etc., etc. Among the contributors of the more purely literary and artistic papers were Mr. Sala, Mr. Edmund Yates, Mr. Tegetmeier, Mr. Hollingshead, Mr. W. M. Rossetti, Mr. J. Hain Friswell, Mr. Percy Greg, and others who have since become more or less widely known by their writings.

The *Register* was continued for some three years, but it may be doubted whether, at any time, it secured commercial success. The price at which it was issued involved the necessity for a very large sale, and this probably it never attained. Finally, and fortunately for the world, it had to be abandoned.

Mr. Weldon then directed his attention, by what special inducements, at the moment, we possess no sufficient knowledge, to the subject of industrial chemistry. Brought up in the tenets of the school of Swedenborg, to which he was ever deeply attached, he had made the acquaintance of Mr. C. T. Hook, the well-known paper manufacturer of Snodland, near Rochester, who was also a Swedenborgian, and this may possibly have led him to direct his attention to the particular branch of industrial science to which, by "cheapening every sheet of paper in the world,"—to adopt the words in regard to his work of the eminent French chemist Dumas,—he was to be indebted for his fame as a discoverer and a benefactor of his race.

Arriving now at the commencement of Mr. Weldon's career as a technological as well as a scientific chemist, we find and are struck with the fact that in this career are displayed the marks of true inborn genius, genius of a kind peculiarly British, and which rose, as with Watt, Stephenson, and others, casting aside impediments and difficulties, to ordinary men insurmountable.

It has been said that genius only amounts to an immense capacity for hard work. No doubt, such a capacity must be present, and must be exerted to produce brilliant effects, but we believe that besides this, there are the special gift of an inspired soul, a fixed and ever-burning desire drawing towards that which is great or good, together with that of a clear mental vision, stimulating and calling into play the capacity for work which is given to every man, according to his physical condition.

Mr. Weldon, as we have seen, was not instructed, still less experienced, as a chemist, but rather as a writer and an editor of works of general literature. The time about which the *Weldon's Journal* was abandoned was the year 1863, and the nearest date to this at which any particulars are to hand relating to the transition period of his career, as it may be termed, is 1865.

In 1863, having reached what once appeared to him in a certain sense the goal of his modest aspirations and hopes, Weldon found, instead of pecuniary reward, pecuniary loss—*but*, he found besides, a new region with an apparently limitless horizon, for him almost without landmarks, and the paths of which when followed up gradually seemed to become mere tracks, these soon melting away to blend with the great unknown expanse before him. But, possessing genius, the new land, with what little he knew of it, presented irresistible fascination, and being further impelled by necessity, besides having the indomitable perseverance and courage of the true Briton, he explored the land, found his right path, and discovered eventually too that he had only missed his first goal to attain a higher: how much higher we are now to record.

Let us see how this is borne out. From some notes with which we have been favoured by Mr. John Spiller, we gather that in 1865 Walter Weldon was already engaged with the invention of certain chemical processes. On Monday, September 18, 1865, according to appointment, Mr. Spiller met Mr. Weldon with his friend Mr. Greg, for the purpose of hearing the details of these processes described in confidence, and of giving an opinion. The proposals referred to the manufacture of magnesium and aluminium by two new processes. For the first, Weldon proposed to heat together magnesia and iodide of sodium, whereby he obtained a double iodide, which was said to be easily decomposed by sodium, or even by lead, with production of metallic magnesium. The second suggestion was to flux cryolite with chloride of calcium, and to use this mixture as a source of aluminium, instead of the more expensive chloride demanded by Deville's process.

Col. Gamble, who next interested himself in Mr. Weldon's experiments, and at whose works in St. Helens the experiments leading to the foundation of the Weldon Process were actually wrought out and the process itself was adopted, has kindly supplied the following particulars in a letter:—"I cannot now remember," writes Col. Gamble, "by whose intervention I first knew Mr. Weldon, but our first meeting was in London in the latter part of 1866, when he repeated before me in my bedroom at the Tavistock Hotel, some experiments which he had made on the producduction of soda by the decomposition of common salt by hydrofluoric acid, and which I believe he had patented. My opinion of this process being unfavourable to its success, in the first instance on account of the impracticability of obtaining apparatus capable of resisting the action of the materials, he called my attention to some experiments he had made on the oxidation of protoxide of manganese by blowing air through it whilst suspended in water, by which he thought he had obtained a peroxide.

"At this time, he appears to have been totally unacquainted with quantitative chemical analysis, or the results to be obtained from it, and I informed him that his process had been worked on a large scale by Mr. Gossage at Stoke Prior in Worcestershire several years before, with the result of only obtaining a very light sesquioxide, which it was found was a very unsatisfactory material to work with in obtaining chlorine, and the process was therefore abandoned.

"I had a considerable number of experiments made at my laboratory in St. Helens, extending over a long period, most of the time under Mr. Weldon's supervision, when it was discovered that the presence of chloride of calcium and an excess of lime along with the protoxide to be oxidised, was necessary for the production of a higher oxide than sesquioxide. But our experiments did not lead us to what appeared to me a workable process. Sometime in 1867 Mr. Weldon discovered the magnesia manganese process, which he patented, and the experiments upon it, conducted on a manufacturing scale, delayed our progress with the lime process, which we did not get to work for making bleaching powder till sometime in 1868. In the meantime some experiments had been conducted by Mr. Weldon on the Tyne (I believe at the Walker Alkali Works), so it was not until sometime in 1869 that we worked the process on a manufacturing scale."

The extracts from Mr. Spiller's notes and Col. Gamble's letter may be usefully supplemented by the following, written by Mr. Weldon himself, and taken from the *Newcastle Chronicle* of July 5th, 1884:—"The first experiment, other than laboratory experiments, with what is now known as 'The Weldon Process,' were made at Walker, in the demolished works of the Walker Chemical Company, about the year 1866. After having reached a certain point the experiments at Walker were abandoned for various reasons. They were soon afterwards resumed at the works of Messrs. J. C. Gamble & Sons, at St. Helens, Lancashire, and it was there that the process was finally worked out."

It will be seen from the extract from Colonel Gamble's letter how much knowledge, as well as experience in theoretical and applied chemistry, Mr. Weldon had yet to acquire in 1866. The writer has before him a letter dated March 8th, 1883, acknowledging the receipt of an address on the subject of instruction in applied chemistry, in which he (the writer) had unwittingly referred to Mr. Weldon as "a trained

chemist," in the ordinary sense of the term. The following is the extract of that letter bearing reference to the matter:—

"I have read with great interest your lecture," writes Mr. Weldon, "report of which you so kindly sent me recently, and I heartily agree with its general argument. But it was a mistake to quote me as an example of a 'trained chemist.' I never heard a chemical lecture in my life. Though few men were more intimately acquainted with the whole *literature* of chemistry, I had never entered a chemical laboratory, or seen a chemical experiment, when I patented, not Weldon's process as it is, but what *led* to it!"

This extract, coupled with the information given by Mr. Spiller and Col. Gamble, throws much light backwards, as it were, on the probable nature and direction of the toilsome reading and study which must have largely occupied nearly three years preceding 1865, and following the abandonment of the *Weldon's Journal* in 1863. It may be safely inferred that a large proportion, both of time and strength, was during this period devoted to the study of chemical literature.

If any man desire then to know what genius is, as well as what hard work may do, let him read first the extracts referring to 1865 and 1866, and secondly, let him read, if he had not the good fortune to hear, that Address delivered in 1884 at Newcastle-on-Tyne, at the close of Mr. Weldon's presidential year with the Society of Chemical Industry.

With regard to the discovery of the chemical reactions and their utilisation, which led to the great Weldon Process, we have a full description from Mr. Weldon's own pen in the last number of this Journal, page 525, as well as a foreshadowing of further problems for future working out, should life have been spared to him. Suffice it to say, that after many experiments with the object of recovering the manganese as peroxide, which had previously been lost as chloride in the liquors, run from the chlorine stills of the bleaching powder manufacturer, he at length succeeded in his design.

The manganese formerly lost was recovered to the extent of 90 to 95 per cent.; the price of bleaching powder was reduced by £6 per ton; its production was quadrupled, and something like £750,000 per annum were added to the national wealth. As M. Dumas, the great French chemist, observed in his address when presenting to him the gold medal of the Societé d'Encouragement, "By Mr. Weldon's invention, every sheet of paper and every yard of calico has been cheapened throughout the world."

This was a notable achievement, and was recognised nowhere more cordially than in France. By the French Government Mr. Weldon was nominated Chevalier of the Legion of Honour, and he received, as we have said, from the Société d'Encouragement its great medal, conferred on only four other persons, Lesseps, Boussingault, Deville and Giffard. Nor did this great service to the cause of Industrial Chemistry pass unrecognised by the leaders of scientific thought in his own country, for on the 8th of June, 1882, Weldon was elected a Fellow of the Royal Society.

He was a man of prodigious energy and perseverance, coupled with knowledge of the world and capacity for business; and to these qualities was largely due the rapid and successful adoption of his invention. He spared no pains and neglected no details. Nor was his attention limited to his own invention. He had made himself more or less familiar with all branches of chemical industry, and in the alkali trade was regarded as an expert whose judgment was of the highest value.

He was a leader in the formation of the Society of Chemical Industry, the welfare and progress of which lay very near his heart. As President of that Society he delivered, as has been already mentioned, an address at Newcastle-on-Tyne in 1884, which excited extraordinary interest. Granted the correctness of all the premises, as a piece of scientific literature this is a perfect model of lucid reasoning, besides possessing, for writing of such a kind, a strange fascination for the reader.

To his scientific attainments he united, as may indeed be now inferred, singular literary skill; and there was not perhaps another man in England who could make a difficult matter more plain to people of ordinary intelligence, and this without the least sacrifice of accuracy or evasion of detail.

Mr. Weldon's earnest devotion to official duties during his presidentship of the Society of Chemical Industry in 1883-4, will probably never be forgotten by his colleagues, both of the Council and of the Publication Committee. But he went far beyond ordinary official duties in the self-sacrificing and generous attempt to attain to higher ideal standards set up within himself. It was sufficient for him that help was needed at some point, that someone was wanted, and that he had the ability to render the required assistance, not to justify merely, but to impel him to offer himself. Thus it came about that during his period of office as President, he sacrificed very largely both time and strength, as well as money, in the interests of the Society of Chemical Industry and its Journal. That these are no figures of speech merely, nothing is easier to prove. As one example among many: When abstracts of English patents were generally introduced into the Journal, and difficulty was at first found in getting these abstracts properly made, Mr. Weldon at once undertook the work himself, and for a considerable period the abstracts came in regularly, a considerable proportion of them in his own handwriting. In fact, all the unsigned abstracts appearing in the Journal about the first half of the year 1884, are his work. The following is an extract of a private letter received from him, by the writer, and dated March 1, 1884, with reference to the self-imposed task above referred to, the conscientious carrying out of which, to the very letter, will be sufficiently manifest, after a reference to the Journal and a perusal of some of these abstracts, which are models of their kind. "As regards myself," writes Mr. Weldon, towards the close of his presidential year, "the time the abstracts of patents occupy me is ruinous. Still, I shall not leave the Society in the lurch at any time, whether President or not."

Besides the vast labour and anxieties entailed by the writing, technological researches, etc., involved in the evolution and maintenance of the very numerous patents bearing his name, or taken out jointly with others, Mr. Weldon kept

fully abreast with the advance of the inorganic portion of pure chemical science; and he occasionally contributed papers, which always contained something of original thought, and were always a pleasure to hear or to read. At the meetings of the British Association in Montreal last year, he contributed a paper on the "Periodic Law," and quite recently he had published for private circulation a work "On the Ratios, one to another, of the Atomic Weights of the Elements," Chapter I. This Chapter I. is devoted to "The Glucinum Family."

The idea of the simplicity of matter and the existence of a common element, is a very old one, and one that has been fondly nurtured by physicists of all ages. Prout's hypothesis partakes of the same nature; its unit is, however, arbitrary and suggestive of hydrogen as that common element. Weldon, in this his last work, accepts the relations between the elements in the Newlands-Mendeléeff series as expressive of a common typical structure; he then deduces from the atomic weights of the members of the series taken, a constant which admits of their expression in a relation to one another of a simple character. It is to be hoped that though deprived of his lucid reasoning, a continuation of this work may yet be possible, along the lines indicated in it.

Like so many in this strenuous generation, Mr. Weldon suffered from over-work. Never satisfied with what he had done, he entertained larger designs, labouring unremittingly for their development. Continually warned that the strain on his energies was excessive, he held on in weakness as in strength. For a long series of years he had attended the meetings of the British Association, and went to the recent gathering at Aberdeen, but only to discover that he was too unwell to take his accustomed share in the proceedings. To a friend meeting him as he was on the point of leaving town for Aberdeen, he said: "I am going to the British Association, though I am very unfit. I have never missed a year since my wife and I first attended the meetings, and I do not like to do so now; but it will be the last." He returned to his home, Rede Hall, Burstow, Surrey, on September 16th, and on the 18th wrote to a friend that he "had been ordered to do no work on pain of almost instant death," adding, with reference to some matters of urgency, "I shall do my best." Two days later his life struggle was over, terminating at the age of 53, of disease of the heart,—a career full of achievement, and with what seemed sure promise of yet greater success.

For the following notes on the personal qualities and characteristics of this distinguished man, as well as for those relating to his earlier and literary career, we are indebted to one of his oldest and most intimate friends, Mr. Alaric A. Watts:—

"I have not known," Mr. Watts writes, "any man in whom the intellectual and emotional elements in human nature were so harmoniously and happily married as in my friend. Each took its own place, and fulfilled its own special duties side by side, out of an abundant affluence of both; nor were their combined influences wanting. In him, as was justly remarked at his funeral by one of the friends of his later life, Mr. Alexander Chance, 'Science never operated to chill the heart.' He was generous to a fault; there was indeed in his nature something princely. He loved to make happy and to serve; and the eminently practical character of his imagination enabled him instinctively to seize occasions for doing so which, with the best intentions, might not have occurred to a less gifted nature. With him, benevolence needed no culture.

"The quality in his nature which I have described as 'princely' entered into all his actions, and was a necessary concomitant of all his surroundings. A man of the simplest personal habits and desires, there was nevertheless in him an expansiveness which delighted to surround itself with what was beautiful and grandiose—a certain largeness which made space and dignified environments a necessity of his being. There was nothing in him in any respect small or narrow. He 'dwelt ever in large places.' His address and deportment to all persons was frank and cordial; gentle, and, when the occasion demanded it, instinct with a modest and gracious dignity that was extremely engaging. He possessed much tact and delicacy of feeling, associated ever with entire sincerity and truthfulness, and a firm and resolute will. He was endowed, in a remarkable degree, with that capacity for taking pains which a high authority assures us is the invariable accompaniment of true genius, if indeed it does not constitute it. No matter, either of business or otherwise, with him was so insignificant as to be dealt with otherwise than in the most complete and perfect way within his knowledge and power. A radical in the true and only real sense of the term, he penetrated ever to the root of things, and was thorough in whatsoever he set his hand to. Notwithstanding the arduous and incessant labours of his life, he found time, either in the early morning or in the watches of the night—which his persistent activity of brain rendered too frequent,—to keep himself fairly abreast of the miscellaneous literature of the day, supplying himself with whatever was of genuine excellence in all its branches. He was no patron of circulating libraries, caring little to read a book not worth buying. But his supreme delight was in his garden and pleasure grounds, in the construction and development of which he spent all that he could spare of his time, and possibly, sometimes, more than he could spare of his money.

"As a companion he was cheerful and genial, and eminently sympathetic—not insensible to the charms of light humour, but more instinctively attracted to what was pathetic and of noble sentiment. I cannot conceive the possibility of anything base or unseemly being uttered in his presence. Care had accompanied his march to fame, and sorrow with him was not lacking to temper the heats of prosperity. The loss of one of his sons, a bright and engaging young man, followed soon after by that of his wife, to whom he was tenderly attached, and for whose gratification to him prosperity was mainly valuable, affected with a tender melancholy the later years of his life. Moreover, during all his life he was more or less a sufferer physically. His nerves were too finely strung for much of the work he had to perform, and though in his later years of a robust and vigorous frame and aspect, —some who read these words may recall the terrors of the grip of his strenuous hand,—his

physical strength was not always answerable to the heavy demands made upon it by the energy of his will and his almost morbid sense of duty. He suffered at intervals from violent attacks of neuralgia or brow ague; and the long journeys which he was compelled so frequently to take on the Continent and elsewhere on the affairs of his company and otherwise, were well calculated, by accelerating the action of the heart, to induce the disorder to which he was ultimately to succumb. His interest in the present and his hopes in the future were, however, happily kept alive by his elder son and the present representative of his family, Mr. W. F. R. Weldon, M.A., of St. John's College, Cambridge, and Lecturer on Invertebrate Morphology at that University, married, in 1883, to the eldest daughter of his friend, Mr. William Tebb, of Albert Road, Regent's Park.

"Those who take interest in such matters may care to know that, though perturbing his mind little with party politics, Mr. Weldon was a staunch adherent of Mr. Gladstone. In religious belief, he was a Christian of the Swedenborgian type. These latter views and sympathies led him early to take an interest in the phenomena of modern spiritualism, which he had carefully investigated and in which he believed.

"A short time before his death, the writer received a letter from him, with the concluding paragraph of which he may be allowed to terminate these imperfect notes. 'The last time,' he said, 'I walked in my garden with my dear wife, I noticed, early as it was, the leaves on a certain tree turning brown. We were of course thinking of Dante*. I quoted to her these lines from verses of our poor friend Spencer Hall† :—

"'The Autumn days are come again,
The hedges redden in the lane,
The leaves are golden on the tree,
And golden memories bloom in me.'"

* His younger son, then recently deceased.
† We had met first at this gentleman's house.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885—86.—First Monday in each month (unless otherwise indicated).

SPECIAL MEETING.

October 26.—Mr. Frederick Siemens, being in London, will attend the discussion of his Paper read at the last Annual Meeting, "On Heating Regenerative Gas Furnaces by Radiation from Flame, and on Producers to supply Gas specially Suitable for that purpose, and for the Recovery of By-Products."—(See Journal for July, 1885, pp. 4—39.)

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

November 2.—Dr. C. R. A. Wright, F.R.S., and Mr. C. Thompson—"Notes on the Chemistry of Soap." Mr. V. H. Veley—"On the Lime Process for the Purification of Coal Gas."

December 7.—Dr. P. F. Frankland on "Some Aspects of Filtration and other Methods of Water Treatment." Dr. F. L. Teed—"Note on the action of Calcium Carbonate on Solution of Ammonium Chloride."

January 4, 1886.—Mr. G. E. Davis—"On the Enrichment of Coal Gas by certain Hydrocarbons." Mr. C. T. Kingzett—"Notes on Russian Turpentine."

February 1.—Mr. Gustav Bischof—"Notes on Dr. Koch's Water Test." Mr. J. W. Westmorland—"The Estimation and Valuation of Copper Ores and Products for Commercia Purposes."

March 1.—Mr. Boverton Redwood—"Researches on Viscosity."

April 5.—

May 3.—Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy—"Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Manchester Section.

Chairman: Sir H. E. Roscoe.

Vice-Chairman: I. Levinstein.

Committee:

R. F. Carpenter.	D. B. Hewitt.
C. Estcourt.	C. Schorlemmer.
H. Grimshaw.	Watson Smith.
B. W. Gerland.	L. Siebold.
Peter Hart.	Wm. Thomson.
T. Jackson.	D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885—86.—First Tuesday in each Month, at 7 P.M.

November 3.—W. Thomson—"Indiarubber and its Decay." Dr. B. Gerland—"Potassium Antimony Oxalate." G. E. Davis—"The Valuation of Crude Naphthas of Commerce."

December 1.—A. H. Allen—"Further Notes on the Chemistry and Analytical Examination of Fixed Oils." Watson Smith—"The Violet Stains appearing on Sized Cotton Cloth" (*Experimentally Illustrated*).

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in the Production of a Compressed Gaseous Compound, for use in Gas Motors and for other purposes, and in Apparatus therefor. Emil Capitaine and Oscar Brünler, Berlin. Eng. Pat. 7581, June 22, 1885.

A SUITABLE liquid hydrocarbon is forced into a strong closed vessel to which heat is applied. The vapours evolved are allowed to escape under great pressure to a properly constructed receiver, passing on their way through an injector-like apparatus whereby sufficient air for combustion is drawn in and mingled with the vapours. This gaseous mixture is ready for explosion in the cylinders of gas engines, and is to be so admitted that the fresh charge expels the spent gases from the cylinder. —A. R. D.

II.—FUEL, GAS, AND LIGHT.

Improvements in the Manufacture of Gas. J. Quaglio. Chem. Zeit. **9**, 959.

REFERRING to Fahnehjelm's invention, the author considers that an important step in the progress of the gas

industry would be realised, should the process prove to be successful. It is based on the use of water gas for illuminating purposes without carburetting, by raising threads or needles of magnesia to a white heat by the flame of the gas. In discussing the improvements in the manufacture of gas during the last ten years reference is made to the use of gaseous fuel for heating gas retorts. It is stated that formerly all the coke produced in gas making was used as fuel, whilst at the present time the average consumption is only about 33 per cent., the Munich gas-works using as little as 15·75 per cent. of the coke produced. The first attempts to apply regenerative furnaces for the heating of gas retorts were made in Germany by Oechelhäuser, general manager of the Dessau works. Of the many systems now in use in Germany and England the author refers to the following as being the principal ones: Siemens' system, the process invented by Schilling and Bunte, and the Hasse-Didier and Hasse-Vacherot systems. These furnaces are constructed on the principle of utilising the waste heat by passing it through a series of flues and thus heating the air necessary for promoting combustion. A further improvement is the construction of a mouth-piece for gas retorts invented by Morton, which requires no luting. Hasse, of Dresden, has improved the construction of hydraulic mains, the object being to prevent the stoppage of the pipes. His apparatus admits of the removal of the tar, whilst the retorts are at work, without loss of gas. In conclusion the author briefly refers to the use of Körting's injectors for exhausters, the scrubbers patented by Kirkham, the construction of gasometer according to Sutze's principle and other arrangements relating to gas-making.—D. B.

Production of Coal in France during the year 1884. Chem. Centr. **16**, 590—591.

COAL AND ANTHRACITE.

Localities.	1883.	1884.
Nord and Pas de Calais	9,944,868	9,430,504
Loire	3,640,777	3,211,509
Gard	2,005,473	1,939,675
Bourgogne and Nivernois	1,635,580	1,605,631
Tarn and Aveyron	1,153,241	1,153,279
Bourbonnais	1,035,874	928,890
Auvergne	345,510	339,571
Hérault	277,898	272,659
Creuze and Corrèze	183,446	205,228
Vosges méridionales	207,455	192,017
Ouest	181,681	177,469
Ouest Alps	147,202	167,885
Manres	424	401
Pyrenees	—	—
Total number of tons	20,759,429	19,624,718

BROWN COAL AND LIGNITE.

Localities.	1883.	1884.
Provence	520,201	451,937
Comtat	30,764	28,727
Vosges méridionales	10,459	10,101
Sud-Ouest	11,065	8,950
Rhône Sup.	1,966	2,776
Total	574,455	502,491
Total	21,333,884	20,127,209

—S. R.

Calorific Power of Coal-gas variously diluted. A. Witz. Compt. Rend. **100**, 440.

When mixed with six volumes of air the calorific power is about 5200cal.; before passing through the scrubber and purifiers the same gas gave 5600cal. With 1·25 volumes of oxygen the calorific power was 5 per cent. higher, with 11 volumes of oxygen 4·6 per cent. lower, but with 10 volumes of air it was 2·5 per cent. higher than with six volumes.—S. Y.

The Revivification of Hydrate of Lime after it has been used for the Purification of Gas. John Reid, Birmingham. Eng. Pat. 1084, January 26, 1885.

The lime after being removed from the purifiers is put on an open kiln or stove in a layer of from four to five inches thick, and occasionally turned over. At a temperature of from 120° to 150° F. the impurities are driven off in from two to three hours.—S. H.

Improvements in Apparatus employed in the Treatment of Coal in order to obtain Coke and By-products therefrom. Richard de Soldenhoff, Merthyr-Tydvil. Eng. Pat. 11,967, June 3, 1885.

The coking ovens are of a rectangular shape, and provided on the side, just by the spring of the arch, with openings leading into a conducting flue situated above the side-wall and running the full length of each oven. Each conducting flue communicates with the main collecting flue which is above, and runs the entire length of the whole set of ovens. From the collecting flue the gases pass through two flues situated in the side walls of each oven, one above the other, and then through flues underneath the ovens to the chimney. The air necessary for combustion is heated by passing through small flues grouped about the heating flues beneath the ovens, and then passes to another flue situated between the two heating flues in the side walls. This flue is perforated on the top in one half of its length, and on the bottom in the other half, so that a good distribution of the air is effected, and perfect combustion of the gases ensured. As an alternative arrangement the gases may be led from the conducting flues to suitable washers and scrubbers, returning thence to the collecting flue, and being burned as above described. When this is done it is proposed to pass the gases through a refrigerating condenser consisting of a tube fitted with a screw to lengthen the passage of the gas; the tube being placed in a tank within which cold water is constantly circulating. (Compare this Journal, iii. 510 and 511.)

—A. R. D.

Improvements in and relating to Apparatus chiefly designed for Utilising the Waste Heat from Coke-Ovens, or other Furnaces for Evaporating, Calcining, and other purposes. C. Kingsford, London. Eng. Pat. 2379, June 12, 1885.

Above a coke-oven the inventor disposes a series of tray-shaped shelves so that the gases evolved in the coking may be burned and pass under and over each shelf in succession. Liquids are admitted to the topmost shelf in such quantity that as they flow downwards from shelf to shelf the evaporation is completed when they reach the bottom, where the residue is removed through a manhole.—A. R. D.

Improvements in Apparatus for the Combustion of Liquid Fuel. J. D. Bodwell, San Francisco. Eng. Pat. 7615, June 23, 1885.

This apparatus consists of a closed chamber provided with air inlets and with an opening in one of the sides near the top, for the escape of the products of combustion. The interior is fitted with a series of shelves, one below the other, sloping downwards from the sides, and reaching about two-thirds of the distance across the chambers. Oil is admitted to the topmost shelf and falls from shelf to shelf, burning during its passage, the shelves meanwhile presenting the appearance of sheets of flame. When it is intended to use this apparatus for heating water, pipes containing the water, preferably placed so as to allow of its circulation therein, are arranged suitably in the heating chamber.—A. R. D.

Apparatus for Combustion of Liquid Fuel. Jno. Imray, London. From H. de Bray and C. D. Rosetti, both of Cairo. Eng. Pat. 12,990, June 24, 1885.

This invention applied to an ordinary Cornish boiler may be described as follows: An oil-tank communicates

with a retort situated in the crown of the fire flue by a pipe in which is inserted an air or steam jet. From the retort a pipe leads the oil or gases to a receptacle on the fire bars, to which a supply of air under pressure is also admitted. From this receptacle several pipes provided with small holes run lengthwise in the flue. The gases issue from these holes and burn, heating the retort and also the boiler. The supply of oil to the retort is maintained by the air or steam-jet in the pipe leading from the oil-tank. The fire-bars are covered with some material which is a non-conductor, and excludes the air. A perforated pipe at the bridge of the flue supplies baryta, permanganate of potash or other oxidising agent, to effect the complete combustion of any imperfectly burned gases.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Removal and Utilisation of the Waste Acid of Petroleum and Tar Works. Chem. Zeit. **9**, 777.

Of the numerous methods employed for removing or utilising the waste acids obtained in the purification of crude petroleum and naphtha, the process based on the decomposition of the acid into sulphurous acid is said to be the most useful. In the absence of sulphuric acid works the sulphurous acid produced may be converted into sulphites or thiosulphates, or it may be treated in accordance with Roessler's process, which depends on the fact that an acid solution of copper sulphate, if treated with sulphurous acid in the presence of air, converts a corresponding quantity of the acid into sulphuric acid, which is then allowed to act on metallic copper. The sulphurous acid may be used also for the decomposition of solutions of sodium phenate; it is necessary, however, to remove all empyreumatic substances, which is best effected by passing the acid through a series of vessels, some of which contain water and others concentrated sulphuric acid. The solution of sodium sulphite produced by the decomposition of sodium phenate with sulphurous acid is causticised with calcium oxide, and the calcium sulphite thus formed used for the evolution of sulphurous acid, whilst the caustic liquor is employed for the extraction of fresh quantities of phenol.

—D. B.

Direct Formation of Dibromothiophen from Coal-tar Benzene. Victor Meyer and Otto Stadler. Ber. **18**, 1884.

Thiophen is so much more easily acted on by sulphuric acid than benzene, that a separation of the two bodies may be effected by means of this reagent, but the authors state that bromine gives still better results, the yield of bromo-derivative of thiophen being almost quantitative. A mixture of 500grm. of purest coal-tar benzene with 30grm. bromine was allowed to stand for several hours, being repeatedly shaken. Hydrobromic acid was copiously evolved and the liquid became almost colourless. It was washed with water and caustic soda, and the benzene distilled off from the water-bath. The residual dark-coloured oil was freed from bromine addition products by warming with alcoholic potash, and after addition of water it was hydrolysed. A light yellow oil separated from the distillate, and more was obtained by extraction with ether. The oil was dried with calcium chloride and distilled, and yielded 13grm. of almost pure dibromothiophen. Experiments on the large scale were carried out in the Höchst Dyeworks (formerly Meister, Lucius and Brüning). By the action of 12kilos. of bromine on 200kilos. of benzene, 3·85kilos. of a heavy oil were obtained, and from 100grm. of this the authors obtained 31·7grm. dibromothiophen and 5grm. monobromothiophen. In a second experiment 1kilo. of crude oil yielded 360grm. of the pure dibromo compound.

—S. Y.

On the Reduction of Nitrothiophen to Amidothiophen. Otto Stadler. Ber. **18**, 1490.

This reduction is attended with considerable difficulty, for by the use of ordinary reagents, such as tin and hydrochloric acid, stannous chloride and hydrochloric acid, ferrous sulphate and ammonia, ammonium sulphide, sodium amalgam, zinc dust and acetic acid, zinc dust and ammonia, hyposulphurous acid and so on, either no reaction takes place, or it is so violent that the thiophen molecule is destroyed with evolution of hydrogen sulphide. The author has succeeded in effecting the reduction by dissolving 1grm. mononitrothiophen in 50cc. of alcohol saturated with hydrogen chloride and adding gradually 2grm. granulated tin. The tin is completely dissolved, and a tin double salt of amidothiophen crystallises out, and may be obtained pure by washing with alcohol. The mother-liquor on evaporation yields more crystals, which are best purified by washing with ether. The double salt has the composition

$$(C_4H_3SNH_2.HCl)_2 + SnCl_4.$$

The base was set free by adding the theoretical quantity of hydrogen potassium carbonate, in complete darkness. A clear yellow oil is thus obtained which rapidly becomes resinous even in the dark.—S. Y.

On Chrysene. E. Bamberger and J. Kranzfeld. Ber. **18**, 1931.

According to Graebe and Bungener, who have obtained chrysene by synthesis from benzylnaphthylmethane, the constitution of this hydrocarbon may be thus expressed—

$$\begin{array}{l} C_6H_5 - CH_2 \\ \quad\quad\;\; | \\ C_{10}H_7 - CH_2 \end{array} - 2H_2 = \begin{array}{l} C_6H_4 - CH \\ \quad\quad\;\; \| \\ C_{10}H_6 - CH \end{array}$$

so that chrysene is a phenanthrene in which in the place of a phenylene group C_6H_4, the bivalent naphthalene complex $C_{10}H_6$ occurs. The object of the present research was to confirm the formula for chrysene by analytical means. According to Liebermann, chrysoquinone has the formula $C_{18}H_{10}O_2$. It contains two carbonyl groups in neighbouring positions thus:—

$$(C_{16}H_{10}) < \begin{array}{l} CO \\ | \\ CO \end{array}$$

The correctness of this supposition is proved by the colour which chrysoquinone exhibits when treated with potash, and is supported by the properties which characterise the following derivatives: Chrysoglycollic acid, chrysoketone, chrysofluorene alcohol, and chrysofluorene. The two carbonyl groups of chrysoquinone exhibit reactions similar to those produced by phenanthrenequinone and retenequinone, the ortho-position of which has been conclusively determined. When chrysoquinone is boiled with aqueous solutions of alkalis, chrysoglycollic acid is obtained in precisely the same manner as that in which under similar conditions diphenyleneglycollic acid is produced from phenanthrene. When chrysoglycollic acid is oxidised with potassium dichromate and sulphuric acid, chrysoketone is formed, which on reduction is converted into chrysofluorene alcohol and chrysofluorene; diphenyleneketone when treated under the same conditions yields fluorene alcohol and fluorene. The following is a comparison of the corresponding phenanthrene and chrysene-derivatives:—

$(C_{12}H_8) < \begin{array}{l} CO \\ \vert \\ CO \end{array}$ Phenanthrenequinone.	$(C_{10}H_{10}) < \begin{array}{l} CO \\ \vert \\ CO \end{array}$ Chrysoquinone.
$(C_{12}H_8) > C(OH).COOH$ Diphenyleneglycollic acid.	$(C_{16}H_{10}) > C(OH).COOH$ Chrysoglycollic acid.
$(C_{12}H_8) > CO$ Diphenyleneketone.	$(C_{16}H_{10}) > CO$ Chrysoketone.
$(C_{12}H_8) > CH.OH$ Fluorene alcohol.	$(C_{16}H_{10}) > CH.OH$ Chrysofluorene alcohol.
$(C_{12}H_8) > CH_2$ Fluorene.	$(C_{10}H_{16}) > CH_2$ Chrysofluorene.

—D. B.

Improvements in the Preparation of Mineral Oils for Woollen Manufacturing and other Purposes. J. Swallow, Armley. Eng. Pat. 13,043, July 1, 1885.

To one ton of mineral oil is added 11lb. of borax and 17lb. of common soda in aqueous solution. The whole is agitated together, boiled for a few minutes, and then allowed to stand. The solution sinks to the bottom, and is separated in any convenient way. The oil is now again stirred up with a mixture of fullers earth and water, which is also afterwards allowed to settle out and separated. This process removes from the oil qualities that impair its usefulness for rag pulling, scribbling, and other operations in the woollen manufacture, and also materially diminishes its inflammability.—A. R. D.

Purifying Paraffin Oils. G. T. Beilby, Midcalder. Eng. Pat. 13,446, July 6, 1885.

After the elimination of the basic and acid impurities with sulphuric acid and caustic soda in the usual way, the oil is mixed with a solution of caustic soda in ethyl or methyl alcohol and agitated in a vessel constructed to minimise the loss of alcohol by evaporation. The alcoholic solution of soda holding the impurities, sinks to the bottom on standing, and is separated by decantation. It is treated with open steam to drive off the alcohol. The supernatant oil in the mixing vessel retains a considerable quantity of alcohol, which must be removed by distillation.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

On a New Easy Method of Preparing Diamidotriphenylmethane. G. Mazzara. Gazz. Chim. 15, 50.

The method described by Fischer (*Ann.* 206, 147) is modified as follows:—A mixture of 45grm. benzaldehyde, 90grm. aniline and 100grm. fuming hydrochloric acid, is boiled for some hours in a flask with reversed condenser, the product is diluted with much water, filtered from resinous matter, and the triphenylmethane precipitated by caustic soda in the form of white flakes, which are washed with hot water and recrystallised from benzene. The crystals lose one molecule of benzene at 110°, and then melt at 139°.—S. Y.

Liebermann's Phenol Dyes. T. Lehmann and J. Petri. Chem. Centr. 16, 483—486.

By the action of nitrosyl-sulphonic acid on phenol two very similar colouring matters are obtained, one of which has been described by Liebermann, whilst little is known of the other. The authors prepared the first of these bodies according to Liebermann's directions and investigated its physical properties as well as those of one of its nitro-compounds. The dye is soluble in methyl, ethyl, and amyl alcohols, forming a yellow solution, and in ether, chloroform and acetone; it is less soluble in benzene and toluene, and insoluble in petroleum spirit. It dissolves in concentrated sulphuric acid, giving a dark blue-green colour. Such solutions of different strengths the authors examined spectroscopically, and found that they have characteristic absorption bands; their positions and variations with strength of solution are given in the paper. The dye is soluble in fuming nitric acid, forming a dark brown solution. If the liquid after filtering through glass wool be treated with water, the dye is precipitated as a dark green amorphous substance, which when dried at 100° C. has the following properties. It is soluble in ether giving a chlorophyll-green solution with a carmine-red fluorescence, which is very perceptible even in nearly colourless solutions; also in alcohol and acetone, giving a similarly coloured liquid, mineral acids dissolve it, giving a brown solution. The green colour is destroyed by alkalis and reproduced by acids. The original dye appears to undergo some change when heated with sulphuric acid to about 130° C., and a colouring matter is obtained which when well washed does not show two characteristic absorption bands, shown by the solution of the original dye, and it gives in alkaline solution a blue-violet colour instead of a blue green solution. The colouring matter so obtained resembles litmus in its behaviour, and the authors suggest it as an indicator. The preparation of this body is as follows:—5cc. phenol are mixed with 5cc. of concentrated sulphuric acid and the mixture is cooled, and then 20cc. of nitrosylsulphonic acid are introduced in small quantities at a time. The mixture is heated for some time on a water-bath at about 80° C., and is tested from time to time until the absorption band $B\frac{1}{2}C—D\frac{1}{3}E$ due to the dye makes its appearance. On pouring the solution into 2 litres of cold water the dye separates as a dark-violet amorphous substance. It is filtered, washed and dried at 100° C. It is readily soluble in acetone, ether, and ethyl, methyl, and amyl alcohols, not so soluble in chloroform, soluble with difficulty in benzene and toluene, and insoluble in petroleum spirit. It is soluble in fuming hydrochloric acid to a yellow-red solution, Liebermann's dye when similarly treated giving a cherry-red colour. The spectroscopic properties of the dye are described in the paper. Fuming nitric acid dissolves it, and a dirty-brown body is obtained from this solution by the addition of water, which is soluble in ether, yielding a yellow-brown solution showing no fluorescence. It acts as a good indicator in alkalimetry, except in the case of ammonium salts.—S. R.

Note on a New Class of Sulphonic Acids of the Aromatic Series. Adolf Spiegel. Ber. **18**, 1479—1482.

The author has already shown that azo-colouring matters, formed by the union of a diazo-salt with a phenol or a base, yield with bisulphites, compounds which are soluble in water. If the azo-compound exist as a sulphonate, the reaction takes place readily in a warm aqueous solution. With the free azo-compounds, insoluble in water, the reaction may be brought about in alcoholic solution, for the alkaline bisulphites are soluble in alcohol. The bisulphite compounds obtained from red azo-bodies form yellow solutions, those from blue form red. They all crystallise well, and the crystals are dark and lustrous. They are stable with dilute acids, but decompose when heated or treated with alkalis into the colouring matter and the neutral sulphite. Textile fabrics may, therefore, be dyed by treatment with the aqueous solution of the bisulphite of the azo-body, and subsequent steaming or warming with alkali. The bisulphites are formed by the direct addition of the two bodies, and may be represented by the general formula—

$$\begin{array}{c}X—\underset{\displaystyle H}{\underset{|}{N}}—\underset{\displaystyle SO_3Na.}{\underset{|}{N}}—Y\end{array}$$

The author has not settled yet whether the free acid is a stable or an unstable body, although he has noticed that, on treatment with concentrated acids, the solution becomes coloured before the original azo-colour is precipitated. In order to study the action of bisulphite on other azo-compounds, an alcoholic solution of azobenzene was treated with an alkaline bisulphite, when instead of direct union taking place, a shifting of the atoms occurred and a new sulphonate of benzidine, amidodiphenylsulphaminic acid, $NH_2.C_6H_4.C_6H_4NH(SO_3H)$, was formed. The azobenzene was soon dissolved when the mixture was warmed on the water-bath, but white cauliflower-like masses soon separated. After some hours, these were filtered, washed with alcohol and water, and dissolved in soda. By addition of an acid a glutinous mass of the new body was precipitated. It has acid properties, and forms crystalline alkali salts—*e.g.*, $C_{12}H_{12}N_2O_3S$. That the sulphonic group is combined with nitrogen was shown by the action of concentrated sulphuric acid, which yielded benzidine sulphate, from which the base was liberated and identified. The sulphaminic acid evidently belongs to the group of bodies, the typical member of which was prepared by Fremy by the action of a nitrate on a sulphite (*Ann. Chem. Phys.* (3), 15, 408). When an aromatic nitroso-compound such as nitrosonaphthol is warmed with a bisulphite, the former is dissolved, and on addition of an acid, a yellow powder soluble in alkali is precipitated. It is reprecipitated from its alkaline solution by addition of an acid, and when heated with water to 150° yields naphthohydroquinone. Also some nitro-compounds, for instance nitrophenanthrenequinone, were acted on by bisulphite, and similar results obtained.—S. Y.

Theory of the Formation of Rosaniline in the Nitrobenzene Process. M. Lange. Ber. **18**, 1918.

It is usually assumed that the nitrobenzene in supplying the oxygen required for the rosaniline formation is itself reduced to aniline and partly enters the rosaniline molecule. The author considers that this is not the case, but that the nitrobenzene loses its nitrogen and is completely reduced to benzene. 40grm. of a mixture of aniline and toluidine were half neutralised with HCl and heated with 20grm. of nitrobenzene and a small quantity of ferric-chloride or ammonium vanadate to 190°; besides rosaniline the melt contained phosphine, an induline-like body, and diphenylamine, and benzene occurred in the distillate. The same melt was obtained by replacing the nitrobenzene by chloronitrobenzene, no chlorinated rosaniline being formed. Exactly the same result was produced by the employment of nitraniline, dinitrobenzene, nitronaphthalene, etc., nitrogen being evolved and the hydrocarbon formed. If pure paratoluidine, half neutralised with HCl, was heated with nitrobenzene and ferric-chloride, hardly any rosaniline was obtained, whereas if the nitrobenzene were reduced to aniline during the process rosaniline must have been produced. If nitro-bodies containing methyl groups be used the reaction is more complicated, since the CH_3 groups appear to get oxidised off and form the nuclei of the rosaniline molecules. Thus if pure aniline (obtained by repeated treatment with small quantities of iodine until it no longer gave rosaniline on heating with nitrobenzene) was half neutralised with HCl and heated with *p*-nitrotoluene and $Fe\,Cl_6$, a good yield of rosaniline was obtained, and the distillate contained benzene. The same result was obtained by the employment of *o*-nitrotoluene, *p*-nitrotoluenesulphonic acid, dinitroxylene, and trinitromesitylene, the rosaniline formed being in all cases identical. With dinitroxylene and trinitromesitylene an evolution of methylchloride and chlorinated derivatives of methane was noticed during the reaction.
—A. G. G.

Cochineal and Cochineal Carmine. C. Liebermann. Ber. **18**, 1969.

The present state of the literature of this subject is very defective; for instance, the author finds that the finest kinds of cochineal contain only about 10% of pure colouring matter, whereas the percentage usually given is 34—50, and also in many other points arrives at conclusions different from those previously given. The percentage of colouring matter in ordinary cochineal was determined by precipitating the aqueous solution with lead acetate, purification of the lead compound, determination of the lead contained in it, and of the colouring matter by difference. Cochineal carmine is insoluble in alcohol, and nearly insoluble in water. An analysis of a very pure specimen gave the following results:—

Water	17	per cent.
Nitrogenous substances	20	,,
Colouring-matter	56	,,
Ash	7	,,
Wax	traces.	

The nitrogen, which amounts to about 3·7% on the dry carmine, is probably chiefly present as albuminous substances, since on fusion with KOH a smell of indole is produced. The ash contained—

Al_2O_3	43·1	per cent.
CaO	44·8	,,
MgO	1·0	,,
Na_2O	3·2	,,
K_2O	3·6	,,
P_2O_5	3·2	,,
SnO_2	·7	,,

and small traces of Fe, Cu, and SiO_2; the tin and copper are probably only accidental impurities. The Ca, Al, and Mg are present in the proportion

$$Al_2O_3 : \overbrace{CaO + MgO} = 1 : 2$$

analogous to the proportion of Al to Ca found by Kopp in fabrics dyed with Turkey-red. The dyestuff dissolves in ammonia to a clear solution from which the Al and Ca cannot be precipitated. On heating the dry carmine to 180° it is converted into ruficarmine, and at a still higher temperature (250°) evolves CO_2, apparently showing that the dyestuff is a carboxylic acid. The author could obtain no confirmation of the statement that the dyestuff is a glucoside.—A. G. G.

On the Wax and Fat of Cochineal. C. Liebermann. Ber. **18**, 1975.

The statement that cochineal contains stearin and margarin is erroneous. The author has separated a wax and a fat neither of which contain the above bodies. The wax is obtained by extracting the cochineal with benzene, and consists almost entirely of a substance to which the author gives the name coccerin. After the removal of the coccerin the fat is extracted with ether; it consists of myristin and an oil containing fatty acids. The following are the percentages of coccerin in various samples of cochineal (extracted with benzene whole):—

Silver cochineal	1·0	per cent.
Mexican silver cochineal	1·7	,,
Teneriff silver cochineal	2·0	,,
Zaccatille	0·5	,,
Teneriff black cochineal	0·7—1·0	,,
Mexican black cochineal	1·5	,,
Granilla	4·2	,,

By powdering the cochineal before extraction the percentages increased by about one-half, except in the case of Granilla, where the granules are exceedingly small. The percentage of myristin is on the average about 1·5—2·0, and of fluid fat and fatty acids 4·0—6·0, so that the average total quantity of wax and fat contained in a silver cochineal is about 12%. After recrystallising from benzene or acetic acid coccerin forms thin glistening plates of melting point 106°, it is sparingly soluble in all cold solvents and nearly insoluble in alcohol and ether. It has the constitution $C_{30}H_{60}(C_{31}H_{61}O_3)_2$. On saponification with alcoholic KOH it gives cocceryl alcohol $C_{30}H_{60}(OH)_2$ and cocceric acid $C_{31}H_{62}O_3$. The alcohol forms a white crystalline powder of melting point 101—104°. The acid melts at 93° and is soluble in hot alcohol, benzene, etc.; its ethyl ether melts at about 70°. The myristin $C_3H_5(OC_{14}H_{27}O)_3$ forms colourless crystals of melting point 55°, easily soluble in warm alcohol, etc.; on saponification it gave glycerol and myristic acid $C_{14}H_{28}O_2$ of melting point 54° and boiling point 248° at 100mm.—A. G. G.

Improvements in the Manufacture of Extracts and Liquors of Logwood. C. E. Avery, Florida, U.S. Eng. Pat. 7630, June 23, 1885.

This process consists in heating the logwood with chlorates or nitrates to the boiling point, or preferably under pressure at heats above the boiling point. A logwood yielding 10% hæmatoxylin requires about 1·4% of its weight of $KClO_3$ or nearly 3% of $NaNO_3$. The inventor claims that by this method the hæmatoxylin is completely oxidised to hæmatein, and that therefore there is no necessity for the use of oxidising substances in the subsequent dyeing or printing; and hence no loss by precipitation in the dyeing and no risk of tendering in the steaming after printing. He claims also that the colour yielded is fast. Hypochlorites acting in the cold give the same result, but are not so uniform in their action.—J. H. H.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in the Treatment of Cotton Seed for the Removal of Fibrous Matter therefrom, and an Apparatus therefor. William Henry Stead. Eng. Pat. 13,831, October 20, 1884.

Cotton-seed is placed in a cylindrical pan having a perforated false bottom. Through the bottom of the pan a vertical shaft armed with stirrers passes; this can be driven at any speed by suitable gearing. The seed is

moistened with strong sulphuric acid and the stirrers set in motion. The proportion of acid varies from $2\frac{1}{2}$ to 4lb. per 100 of seed. The stirring is continued until the fibres surrounding the seed are detached from the seeds in the form of a fine powder: this escapes through the false bottom and through a spout provided for the purpose. The seed is then sprinkled with powdered lime, the stirring being continued. The excess of acid is thus removed as a fine powder of sulphate of lime and the seed is left clean. A thin coating of lime dust remains, however, which can be easily removed by means of a brush and screen. A drawing accompanies the specification. —E. J. B.

An Improved Process for Treating old cotton, or other Ropes, and Cotton or other Waste, to be used as Engine-cleaning Waste. H. M. Semmons and V. Nathan. Eng. Pat. 14,338, October 30, 1884.

The patentees open—if required—the ropes or other waste by the usual methods, and then dye the materials with aniline or other dyes. They claim that the dyeing "removes or counteracts the grease in the materials and leaves the waste in a better condition for absorbing oil" when used as engine-cleaning waste.—J. H. H.

Improved Apparatus for Wool-washing. L. A. Groth, London. From A. Mouchablon, Paris. Eng. Pat. 14,962, November 13, 1884.

The inventor proposes a mechanical arrangement for a continuous operation. For particulars and drawing of the arrangement the original specification should be consulted.—H. A. R.

Treating Animal and Vegetable Fibres for Textiles, Cordage, and other Uses. Wesley Washington, Hamilton. Eng. Pat. 6922, June 8, 1885.

In this invention animal fibres, as cow-hair and vegetable fibres, like short jute or short flax, etc., which by reason of their structure and length are unsuitable for spinning and weaving purposes, are treated in such a way as to render them suitable for these purposes. The method consists in subjecting the fibres to great pressure in one or more directions. The fibres thus treated are found to possess a certain amount of curliness which greatly improves their spinning properties. The fibre, say, for example, jute, in lengths of about two inches, is shaken up in order to intermingle the fibres and then closely packed in a strong iron cylinder. It is then subjected to such pressure that 65lb. are forced into a space of one cubic foot, for about five minutes. The mass of fibres is then removed and is replaced in the cylinder in such a way that those portions previously occupying a vertical position are now placed horizontally—pressure being again applied as before.—E. J. B.

Treating Animal and Vegetable Fibres for Textiles, Cordage, and other Uses. Wesley Washington Hamilton. Eng. Pat. 6923, June 8, 1885.

This patent differs from the preceding one in that the mass of fibres, after having undergone the pressure treatment, is then tightly bound with cord or wire and boiled in water for one hour. The fibres are then opened out by hand and carefully dried.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Contribution to the Chemistry of Mordants. On the Behaviour of the Solutions of some Salts of Chromium. L. Liechti and H. Schwitzer. Mitth. des Techn. Gewerbe-Museums in Wien, May, 1885. (Compare this Journal, 1883, 537.)

In this paper the authors have studied the behaviour of the solutions of some salts of chromium, the object being to obtain some useful data for the dyeing and printing industries. Normal and basic sulphates, thiocyanates, acetates, sulphacetates, nitro-acetates and chloro-acetates were prepared from chrome alum and chromium sulphate. The behaviour on dilution and heating, as well as towards the fibre during mordanting, hanging and drying, was studied. Experiments were also made having regard to the action of precipitants on these mordants. The results obtained are embodied in a series of tables, which are now given in a more condensed form. (See pp. 588—591). From these tables it will be seen that the normal salts are not dissociated either on boiling or dilution. The basic sulphates are decomposed on diluting. A number of basic acetates, sulphacetates and nitro-acetates were dissociated, whilst the sulphate, thiocyanate and chloro-acetate mordants were not affected. It is further shown that the more basic the mordant the more readily it is decomposed on dilution with water and heating. Owing to the imperfect separation of the chromium, it was impossible to determine the end of the dissociation. The quantity of chromium oxide retained by the fibre during the operations of mordanting, drying and ageing was found to increase with the basicity of the mordant, the strongly basic sulphates yielding the largest quantity of oxide to the fibre, but numbers as high as in the case of some aluminium mordants were not obtained. The behaviour of chrome alum mordants differed from that of chromium sulphate mordants, a circumstance which affords further proof of the influence of potassium sulphate on the mordants prepared from chrome alum. In their previous communication the authors showed that only those basic aluminium acetates which contained a sulphate in solution were decomposed on dilution with water, and in this respect the behaviour of chrome alum mordants agrees with alumina mordants. In regard to the influence of precipitants, it was found that the results differed according as the solutions of the various mordants had been freshly prepared or kept for some time; for instance, freshly prepared chromium acetate resisted the action of precipitating agents more powerfully than after it had been kept. The authors consider that the changes of colour exhibited on heating the mordant solutions are due to the production of basic salts, and not the formation of modifications of chromium hydroxide.—D. B.

Use of Ammonium Carbonate for fixing Alumina Mordants on Cotton. J. Wolf. Mitth. des Techn. Gewerbe-Museums in Wien, May, 1885.

The author has made a series of successful dye tests with ammonium carbonate as a fixing agent for alumina mordants. The advantage gained by the use of this substance is said to depend on the circumstance that pure aluminium hydroxide is produced on the fibre, whilst with the usual cow-dung surrogates basic phosphates, arsenates, etc., are formed, the acids of which are less readily expelled, so that the operation of dyeing is prolonged. The action of ammonium carbonate was tried on the following mordants. The latter were made to contain 100grm. $Al_2(SO_4)_3 + 18H_2O$ in a litre :—

1. Aluminium acetate $Al_2\overline{Ac}_6$. The results were the same whether 5 or 10grm. of carbonate was added to one litre of the mordant. A temperature of 50° gave the best results. The action is more favourable with 20grm. carbonate per litre, and the best results are obtained with 40grm. in a warm solution.

2. Aluminium sulphacetate $Al_2SO_4\overline{Ac}_4$. As in the former case an increase in the amount of carbonate employed intensifies the colour, the best result being obtained when 40grm. of carbonate are used in a cold or warm solution.

3. Basic aluminium sulphate-thiocyanate—

$$Al_2(SO_4)(CNS)_2(OH)_2.$$

In this case satisfactory results were obtained with less concentrated fixing baths.

4. Basic aluminium thiocyanate $Al_2(CNS)_4(OH)_2$. Good results were obtained with smaller additions of carbonate than in the case of mordants 1 and 2.

It is recommended to try experiments on a large scale in this direction.—D. B.

On the Behaviour of Compounds of Aluminium in the presence of Alizarin. L. Liechti and W. Suida. Mitth. de Techn. Gewerbe-Museums in Wien, May, 1885.

The authors have investigated the changes occurring in the practical operations of dyeing and printing with alizarin. The following is a summary of their observations :—

1. Pure aluminium hydroxide *per se* or in the form of a mordant is not dyed by alizarin unless a salt of calcium is present.

2. Normal aluminium alizarate $Al_2O_3(C_{14}H_6O_3)_3$ is obtained by the addition of aluminium sulphate to an ammoniacal solution of alizarin. It is soluble in water, alcohol and ammonia.

3. Basic aluminium alizarates. The following were prepared :—

(*a*) $Al_2(C_{14}H_6O_4)_{1\cdot5}(OH)_3$, insoluble in water, soluble in ammonia.

(*b*) $Al_2(C_{14}H_6O_4)(OH)_4$, insoluble in water and ammonia.

(*c*) $Al_2(C_{14}H_6O_4)_{0\cdot5}(OH)_5$, insoluble in water, sparingly soluble in ammonia.

All basic alizarates are insoluble in alcohol.

4. Normal calcium alizarate, $C_{14}H_6CaO_4$, is obtained by the double decomposition of calcium acetate or chloride and an ammoniacal solution of alizarin. It is a crystalline body, is sparingly soluble in water and is readily decomposed by acids (even oleic acid).

5. Basic calcium alizarates are produced by employing an excess of alizarin. They are soluble in cold water and ammonia. On heating the solution the normal salt is separated and a solution of ammonium alizarate obtained.

6. Excess of alizarin prevents the precipitation of aluminium salts by ammonia.

7. Aluminium calcium alizarates are obtained by dyeing aluminium hydroxide with alizariu in the presence of calcium salts. The following compounds were prepared :—

(1.) $(Al_2O_3)_3(CaO)_4(C_{14}H_6O_3)_{10}$
(2.) $(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_8$
(3.) $(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_{7\cdot5}$
(4.) $(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_{0\cdot75}$
(5.) $(Al_2O_3)_3(CaO)_{1\cdot2}(C_{14}H_6O_3)_{3\cdot6}$
(6.) $(Al_2O_3)_3(CaO)_{2\cdot57}(C_{14}H_6O_3)_{6\cdot45}$
(7.) $(Al_2O_3)_3(CaO)_{1\cdot5}(C_{14}H_6O_3)_4$
(8.) $(Al_2O_3)_3(CaO)_{4\cdot5}(C_{14}H_6O_3)_{10}$
(9.) $(Al_2O_3)_3(CaO)_4(C_{14}H_6O_3)_{10}$
(10.) $(Al_2O_3)_3(CaO)_{4\cdot2}(C_{14}H_6O_3)_{10}$

All these lakes are insoluble in water. Nos. 1, 2, and 3 are readily soluble in ammonia; 4, 5, and 6, partially soluble in ammonia; whilst Nos. 7, 8, 9, and 10 are insoluble in ammonia. It is remarkable that lake 1 is readily soluble in ammonia and lake 9 insoluble, seeing that the composition of both is the same.

8. The formation of aluminium calcinm alizarates shows that the absorption of lime by the lake depends on the amount of alizarin employed, although the absorption of alizarin is limited by the quantity of calcium present.

9. In most cases alizarin and Turkey-reds contain a large excess of alumina in comparison with the amount of lime and alizarin present.

10. On dyeing cloth mordanted with alum na in a bath of alizarin and calcium acetate, 1mol. i alizarin absorbs ⅓mol. lime.

11. The most probable formula for norma alizarin red (not soaped) is $(Al_2O_3)(CaO)(C_{14}H_6O_3)_3H_2{}^1O$.

12. This lake dissolves readily in ammonia, and its solution can be mixed with Turkey-red oil without being altered.

13. The compound $(Al_2O_3)(CaO)_2(C_{14}H_5O_3)_5$, described by Saget as alizarin or Turkey-red, is soluble in water.

14. This substance is not produced during the dyeing operation, even under pressure, but a basic lake is invariably formed.

15. On treating these lakes with Turkey-red oil, fatty hydroxy-acids are absorbed from the oil by the lakes. The sulphuric acid, set free by the decomposition of the fatty sulphuric ether, decomposes a corresponding quantity of the lake. Alizarin is liberated and the sulphates of calcium and aluminium are formed.

16. The ratio of lime to alumina is altered during the soaping process in the case of alizarin-reds as well as Turkey-reds. Alizarin-reds absorb fatty acids from the soap during this operation.—D. B.

Preparation of Carmine. L. Sedna. D. Ind. Zeit. 26, 105.

In making carmine, care should be taken that the materials used are free from iron, that the water is soft, or better, distilled, and that soap has not been employed to wash the linen used. Temperature and light influence the colour of the product, the brightest tint being obtained when there is a maximum amount of sunshine. Madame Cenette recommends boiling 1kilo. of the cochineal with 75kilos. of distilled water for two hours, then adding 25grm. of pure saltpetre, and finally, after three minutes, 30grm. of oxalic acid. The whole is allowed to stand for three weeks, the liquid removed as far as possible by means of a pipette, and the carmine carefully dried. Carmine is readily soluble in ammonia, and is reprecipitated from this solution by acetic acid and alcohol. As starch and cinnabar are the common adulterants, the carmine can be dissolved out by ammonia, and the residue weighed to give the amount of impurity present. —S. R.

A Black Stain for Wood. Chem. Centr. **16**, 543.

5kilos. of logwood and 4kilos. of gallnuts are mixed with 18 litres of good vinegar, and the mixture allowed to stand for a week. At the end of this time 5 litres of water are added, and the whole evaporated to 10 litres in volume, and the clear liquid poured off. In another vessel 1kilo. of iron filings are heated with 5 litres of good wood vinegar, and the mixture stirred from time to time until the temperature rises to 16° C. The two liquids obtained in this way are mixed, and the pieces of wood to be stained are kept in the solution until the requisite colour is obtained.—S. R.

The Bleaching and Colouring of Straw. E. J. Hödl. Chem. Centr. **16**, 575—576.

The natural colouring matter of straw can be removed by treatment with warm water and a weak ley containing 8 parts potash and 12 parts soda to 50 parts water. The straw is afterwards washed two or three times with still weaker alkali, and finally with warm water. The bleaching process consists in treating the straw first with chlorine, and then with sulphurous acid. But generally a delicate straw shade is required, and to obtain this, the already bleached material is immersed in a bath containing 1·5grm. of picric acid dissolved in 10kilos. of water. If, however, a pure white straw be desired, the partially-bleached material is treated with warm water, then with a dilute soda lye at 50° C. and afterwards in a chloride of lime bath. To this bath dilnte hydrochloric acid is subsequently added, and the straw is removed after half-an-hour. Finally it is washed in a bath of one per cent. soda solution. The straw bleached by this method is pure white in colour and very pliant and elastic. The following recipes for dyeing straw are given. The quantities recommended in each case are sufficient to dye 10kilos. of straw. Black : Heat for two hours in a solution of 2kilos. log-wood and 500grm. sumach, then in a bath of ferric nitrate solution at 4° B. Another method is to add 125grm. of curcuma to the first solution, and substitute ferrous sulphate for ferric nitrate in the second. Grey : The straw is treated with sodium carbonate solution and a little lime, then with a solution of 2kilos. alum and 100grm. tartaric acid. For special shades a little cochineal or indigo carmine is added. A little sulphuric acid is added to neutralise the cochineal, and the straw is finally washed in acidulated water. Brown : Heat for two hours with 750grm. sandal-wood, 1kilo. curcuma, 250grm. sumach, and 600grm. logwood, and sadden the shade so obtained in a bath of copperas. Or, use 370grm. sandal, 500grm. curcuma,

TABLE I.—SULPHATES (ALUMS).

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2(SO_4)_3$	Chrome alum.	Bluish green.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2523	0·0045	1·78
2. $Cr_2(SO_4)_2(OH)_2$	Chrome alum and sodium carbonate.	Green.	85-fold dilution.	Ditto.	12-fold dilution.	0·2331	0·0177	7·59
3. $Cr_4(SO_4)_3(OH)_6$	Ditto.	Yellowish green.	16-fold dilution.	Ditto.	2·6-fold dilution.	0·2051	0·0161	22·62
4. $Cr_2(SO_4)(OH)_4$	Ditto.	Ditto.	1·5-fold dilution.	Ditto.	0·5-fold dilution.	0·3155	0·2762	87·51
5. $Cr_2(SO_4)_2(OH)_2$	Chrome alum and chromium hydroxide.	Ditto.	85-fold dilution.	Ditto.	10·5-fold dilution.	0·2952	0·0876	29·67
6. $Cr_4(SO_4)_3(OH)_6$	Ditto.	Ditto.	2-fold dilution.	Ditto.	0·25-fold dilution.	0·2558	0·1100	43·00

TABLE II.—SULPHATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2(SO_4)_3$	Chromium sulphate	Green.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2501	0·0323	12·79
2. $Cr_2(SO_4)_2(OH)_2$	Chromium sulphate and sodium carbonate.	Yellowish green.	6·5-fold dilution.	Ditto.	2-fold dilution.	0·2193	0·0855	38·98
3. $Cr_4(SO_4)_3(OH)_6$	Ditto.	Ditto.	1·25-fold dilution.	Ditto.	0·3–0·4-fold dilution.	0·2102	0·1817	86·41
1. $Cr_2(SO_4)_2(OH)_2$	Chromium sulphate and chromium hydroxide.	Ditto.	10-fold dilution.	Ditto.	0·5-fold dilution.	0·2685	0·0751	27·95

TABLE III.—THIOCYANATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying, and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2(CNS)_6$	Chromium sulphate and barium thiocyanate.	Violet.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2335	0·0117	5·01
2. $Cr_2(CNS)_5OH$	Chromium thiocyanate and sodium carbonate.	Bluish-green with reddish reflection.	Ditto.	Ditto.	Ditto.	0·2279	0·0203	8·92
3. $Cr_2(CNS)_4(OH)_2$	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	0·2260	0·0325	14·38
4. $Cr_2(CNS)_3(OH)_3$	Ditto.	Green.	Ditto.	Ditto.	75-fold dilution.	0·2051	0·0429	20·88
5. $Cr_2(CNS)_2(OH)_4$	Ditto.	Bluish-green.	Ditto.	Ditto.	32-fold dilution.	0·2144	0·0722	33·67

TABLE IV.—ACETATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2\overline{Ac}_6$	Chromium sulphate and lead acetate.	Bluish violet.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2332	0·0188	8·12
2. $Cr_2\overline{Ac}_5(OH)$	Basic chromium sulphate, $Cr_4(SO_4)_5(OH)_2$ and lead acetate.	Ditto.	Ditto.	Ditto.	Ditto.	0·2574	0·0663	25·75
3. $Cr_2\overline{Ac}_4(OH)_2$	Basic chromium sulphate, $Cr_2(SO_4)_2(OH)_2$ and lead acetate.	Ditto.	Ditto.	Ditto.	75-fold dilution.	0·2751	0·0813	29·55
4. $Cr_2\overline{Ac}_3(OH)_3$	Basic chromium sulphate, $Cr_4(SO_4)_3(OH)_6$ and lead acetate.	Green.	Ditto.	Is dissociated when heated gradually to 80—90°.	—	0·2200	0·1453	66·05
5. $Cr_2\overline{Ac}_2(OH)_4$	Chromium acetate and sodium carbonate.	Violet.	Ditto.	Ditto.	—	0·2368	0·1654	69·85

TABLE V.—SULPHACETATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2SO_4\overline{Ac}_4$	Chromium sulphate and lead acetate.	Bluish violet.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·3085	0·0784	25·41
2. $Cr_2NaSO_4\overline{Ac}_4(OH)$	Basic chromium sulphate. $Cr_4(SO_4)_5(OH)_2$, and lead acetate.	Ditto.	Ditto.	Ditto.	Ditto.	0·2797	0·0769	27·49
3. $Cr_2Na_2SO_4\overline{Ac}_4(OH)_2$	Basic chromium sulphate. $Cr_2(SO_4)_2(OH)_2$, and lead acetate.	Ditto.	Ditto.	Ditto.	65-fold dilution.	0·2644	0·0880	33·26
4. $Cr_2Na_3SO_4\overline{Ac}_4(OH)_3$	Basic chromium sulphate. $Cr_4(SO_4)_3(OH)_6$, and sodium carbonate.	Bluish green.	Ditto.	Is dissociated when heated gradually to 65—80°.	—	0·3102	0·2610	81·11

TABLE VI.—NITRO-ACETATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing.		
						Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2(NO_3)_2\overline{Ac}_4$	Chromium sulphate, lead nitrate, and lead acetate.	Green.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2358	0·0105	4·15
2. $Cr_2Na(NO_3)_2\overline{Ac}_4(OH)$	Chromium nitrate and acetate, and sodium carbonate.	Yellowish green.	Ditto.	Ditto.	Ditto.	0·2238	0·0245	10·91
3. $Cr_2Na_2(NO_3)_2\overline{Ac}_4(OH)_2$	Ditto.	Violet.	Ditto.	Ditto.	Ditto.	0·1941	0·0128	22·01
4. $Cr_2Na_3(NO_3)_2\overline{Ac}_4(OH)_3$	Ditto.	Ditto.	Ditto.	Ditto.	50-fold dilution.	0·2320	0·1124	48·44
5. $Cr_2Na_4(NO_3)_2\overline{Ac}_4(OH)_4$	Ditto.	Ditto.	Ditto.	Is dissociated when heated gradually to 75—80°.	—	0·2161	0·1493	69·09

TABLE VII.—CHLORO-ACETATES.

Formula.	Source.	Colour.	Dissociation on dilution. Beginning.	Dissociation on heating. Beginning.	Dissociation on dilution and heating (5 minutes). Beginning.	Attraction of the Fibre during Mordanting, Drying and Ageing. Cr_2O_3 presented to the fibre.	Cr_2O_3 retained by the fibre.	Percentage.
1. $Cr_2Cl_2\overline{Ac}_4$	Chromium sulphate, lead acetate, and barium chloride.	Yellowish green.	Is not dissociated.	Is not dissociated.	Is not dissociated.	0·2214	0·0269	12·15
2. $Cr_2Na_2Cl_2\overline{Ac}_4(OH)_2$	Chromium chloride and acetate, and sodium carbonate.	Bluish green with slightly violet reflection.	Ditto.	Ditto.	Ditto.	0·2048	0·0812	39·64
3. $Cr_2Na_3Cl_2\overline{Ac}_4(OH)_3$	Ditto.	Violet.	Ditto.	Ditto.	45-fold dilution.	0·1928	0·0967	50·15

—D. B.

100grm. sumach, and 350grm. log-wood, and afterwards soak the straw in a solution containing 2—3kilos. of alum, and remove when the colour is sufficiently intense. Violet: Heat for two hours with 2kilos. alum, 500grm. tartaric acid, and 500grm. stannous chloride. Straw can be very readily coloured with most of the aniline dyes, and can afterwards be rendered glossy with either gum or gelatine.—S. R.

Improvements in Dyeing Fabrics Aniline Black and in Apparatus therefor. C. R. Preibisch. Eng. Pat. 12,472, September 6, 1884.

THE patentee has devised a new form of apparatus for the oxidation of aniline black which, he claims, gives an excellent black that does not rub off, and obviates all danger of the streakiness which appears in blacks oxidised by hanging in damp air. The apparatus is somewhat similar in form to the large continuous steaming apparatus of Messrs. Mather & Platt. The fabric saturated with the mordants is dried in the front part of the apparatus by means of a current of warm air which, by the aid of fans, is made to circulate between the folds of the cloth, and in the latter part is oxidised at a temperature of 44—50° C., the atmosphere of this portion being kept moist by the use of water troughs at the bottom of the apparatus. By means of guide rollers, the cloth is kept at a perfectly even tension, and proceeds at a uniform rate throughout. Noxious gases are removed as soon as formed by exhaust pipes along the roof. Aniline black on delaines can also be oxidised in this way, and the wool fibres left in a fit condition for subsequent dyeing with log-wood.—J. H. H.

A New Method of Dyeing Silk and Woollen Fibres with Insoluble Azo-colouring Matters. Dan Dawson and G. W. Oldham. Eng. Pat. 13,211, October 6, 1884.

THE inventors have found that if a precipitated naphthol or similar body is added to a weak neutral solution of a diazo-compound, a bath is produced which slowly and gradually deposits an azo colouring matter. Presence of a slight excess of acetic acid further retards the reaction. Thus a 0·1 per cent. solution of xylidine or naphthylamine hydrochloride in excess of HCl, is azotised by means of a weak solution of $NaNO_2$: when the reaction is complete, pure chalk is added till the liquid is neutralised, and then at least 0·1 per cent. finely-precipitated naphthol along with acetate of soda and a little acetic acid. Silk or wool immersed in this bath are effectively dyed, and the rapidity of the operation may be regulated by the addition of a larger or smaller quantity of acetic acid.—J. H. H.

A New or Improved Process for Cold Scouring and Dyeing Cotton. W. H. Beck. From La Société Ch. Taussant et Cie., Paris. Eng. Pat. 13,258, October 6, 1884.

THE patentee acts upon cotton in cops and fleeces in a vacuum apparatus with a 1 per cent. solution of what appears to be a very alkaline "soluble oil" of 50 per cent. strength. If the cotton is in hanks or skeins, the same solution is used, but in the open air. The dyeing operation for cops and fleeces is also conducted in a vacuum: for hanks and skeins in the open air in the ordinary way. If light shades are required to be dyed, ammonia or a carbonated alkali is used in the scouring, and the cloth is soured and washed before dyeing.
—J. H. H.

Improvements in Bleaching. C. F. Cross and J. P. Rickman. Eng. Pat. 13,678, October 16, 1884.

THE cotton or linen goods, having been boiled with lime or alkali in the ordinary way, or steamed according to a former patent (Cross, 4984, Nov. 30, 1884), are immersed in an alkaline solution containing, preferably, about 1 per cent. Na_2O. Milk of lime may also be used. Excess of moisture is then removed, and the goods placed in an

C

air-tight kier: from this the air is withdrawn and replaced by chlorine gas, with which the goods are allowed to remain in contact until the action is completed: or, if necessary, the goods may be again immersed in the alkali, and again treated with the chlorine. The process is best carried on in an apparatus similar to that patented by Thompson (595, Feb. 3, 1883), or in the case of piece goods in the apparatus patented by Mather (7909, May 19, 1884). In the latter case, alkaline solutions may be printed on the cloth, and the effect of a topical discharge produced by passing through the chlorine gas for a few seconds.—J. H. H.

A New Process of the dyeing Black on Cotton, Cotton Yarns, or Cotton Fabric, or other Vegetable Fibre. J. Clare. Eng. Pat. 14,225, October 28, 1884.

The goods are passed through log-wood liquor at 4° T., the excess of moisture removed, after which they are passed through a bath of copperas and alkaline sulphide, the use of the latter being the distinctive feature of the process.—J. H. H.

Improvements in Dyeing with Aniline Black. W. P. Thompson. From A. Descroix, of Villefranche. Eng. Pat. 14,276, October 29, 1884.

This process is applicable to woven fabrics and all kinds of textile material. A cold solution of aniline and a soluble bichromate, is printed or padded on the material, which is then wound upon a small roller, and left until the black is sufficiently developed: this requires from fifteen minutes to fifteen hours, according to the strength of the solution. The goods are then washed, soaped and finished as usual, and it is claimed that no tendering of the material takes place. The best proportions are two parts of bichromate to one part of aniline dissolved in sufficient acid to "saturate the alkali of the bichromate."
—J. H. H.

VII.—ACIDS, ALKALIS, AND SALTS.

Communication on Certain English Chemical Industries. Chem. Zeit. **9**, 851 and 869.

Chrome Green (Guignet's green).—The materials employed for the manufacture of chrome green are acid potassium chromate and boric acid, which on heating give chromium oxide and potassium borate. It is necessary to subject the commercial boric acid to a process of purification which is best effected by dissolving the acid in water, treating the resulting solution with animal charcoal, and allowing the clear solution to crystallise. The crystallised mass is dried in centrifugal machines. The mother-liquor may be employed for dissolving fresh portions of boric acid, but should not be used more than four or five times. The charge consists of eight parts boric acid and three parts acid potassium chromate, both being in a finely-divided and intimately-mixed state. The furnace is so constructed that the flame first passes over the charge, and is then led away under the bed of the furnace. For each operation about 45kilos. of the above mixture is taken, the roasting being completed in about four hours. The temperature should not exceed that of a dark-red heat. The fused mass is thrown into water and washed repeatedly by decantation, the first and second wash waters being reserved for the recovery of the boric acid, whilst the third washings are used as water for the first extraction. The purified pigment is then placed on cotton filters, allowed to drain and passed through colour mills (wet mills). After grinding the mass is again washed with hot water, filtered and pressed, so that a product is obtained which contains 33 per cent. of dry matter, and yields 26 per cent. of residue when ignited. For the recovery of the boric acid the washings are evaporated in leaden pans to 13° B. and treated with hydrochloric acid, potassium chloride and boric acid being obtained. The latter crystallises out on cooling. The mother-liquors are concentrated to 20° B. The crystals which are thrown out are dissolved, and the solution is treated with hydrogen sulphide to remove the lead absorbed by the liquors. The mixture is filtered, the solution evaporated and allowed to crystallise. Only 65 per cent. of the boric acid originally employed is recovered.

Tin Salt.—The action of hydrochloric acid (which must be free from iron if a pure product is required) on tin is effected in stone vats capable of holding 400kilos. of tin, and 875kilos. hydrochloric acid of 20° B. Having introduced the charge it is heated gently for twelve hours, after which it is drawn off and allowed to settle. The clear solution is then concentrated in copper pans to 68° B. and allowed to crystallise. The crystals are dried on slate slabs or by centrifugal machines. In order to prevent the action of the tin solution on the copper pans it is necessary to have free tin constantly in the pan. The casks used for packing the crystals are lined with paper saturated with paraffin.

Sodium Stannate.—Ten half-round cast-iron boilers 0·75m. in diameter, and grouped together in horse-shoe form, are built in brickwork and heated gently by a furnace placed at one end of the series. A metal tube is fixed in the centre of each boiler, the lower end of which forms a perforated funnel. A syphon is dropped into the tube at the end of the operation in order to withdraw the tin solution. Each boiler is almost filled with granulated tin, and six out of the ten boilers are charged with soda ley of 15° B. The liquor is then passed from one boiler to the other until it shows a density of 30° B., when it is drawn off into an iron tank and allowed to settle. In order to prepare the "sodium stannate liquor," the solution is treated with the requisite quantity of common salt to reduce the amount of tin to 5 per cent., whilst for the production of the solid salt the solution is evaporated to dryness in a cast-iron boiler. After calcining the residue the dried salt is mixed with common salt, so that a product containing 42 per cent. of tin is obtained.

Nitric Acid.—For the manufacture of nitric acid cast-iron cylinders 0·75m. in diameter and 2m. in length, or cast-iron stills 3m. long, 1·4m. wide, and 0·9m. high, lined with stone slabs and set in brickwork, are used. The charge consists of 250kilos. of saltpetre and 310kilos. sulphuric acid of 60° B.

Arsenic Acid.—This acid is prepared by the action of nitric acid on arsenious acid. The operation is effected in stone vats, holding from 65 to 70kilos. of arsenious acid.—D. B.

Solubility of Salt Mixtures. Fr. Rüdorff. Sitzber. der Berl. Akad. der Wissensch, 1885, 355.

A large excess of the two salts, finely-powdered and mixed, was warmed with a known quantity of water, repeatedly shaken, and then allowed to cool to the temperature of the room. Three equal portions of this solution were taken, and to the first a known weight of one of the salts was added, and to the second a like quantity of the other salt, the third remaining unchanged. The three solutions were frequently agitated, and after some time filtered from the separated crystals and analysed. Two series of experiments were conducted. 1. When no chemical interchange was possible, as when two salts with the same acid or base were mixed. 2. When a double decomposition was possible, as when salts with two acids and two bases were mixed. This paper was confined to the consideration of the first of these two classes of reactions. When the two salts used were capable of uniting to form double salts—*e.g.*, ammonium and aluminium sulphate—there was a marked displacement of one constituent salt by the other, or rather a displacement of the double salt by one of its constituents. This was shown by adding one of the constituent salts in a finely-divided state to a saturated solution of the double salt. The same was the case with isomorphous salts, but with mixtures of salts which neither formed double salts nor were isomorphous no displacement of the one by the other was noticed. A molecular attraction exists then between the constituents of double salts, and between salts of the same isomorphous group, different from that between any two salts. The fact that double salts crystallise better from a solution which contains an excess of one of the two constituents is explained by these experiments. These phenomena can

be shown in the case of isomorphous salts by the growth of a crystal of chrome alum in a saturated solution of ordinary alum, and by suspending a crystal of calcspar in a solution of ferrous carbonate in water charged with carbonic acid.—S. R.

On the Existence of Nitrous Anhydride in the Gaseous State. G. Lunge. J. Chem. Soc. (Trans.), 1885, 457.

This paper is entirely controversial, and the author criticises adversely the methods of experiment and the conclusions deduced in the researches of Ramsay and Cundall on the above subject, and complains that his own results had been overlooked by the later experimenters, who had adopted opposite views without disproving results previously published. The author maintains the validity of his deductions, which are to the effect that N_2O_3 may exist in the gaseous as well as in the liquid state. His argument as against his opponents is that their material must have been impure, and was obtained only by passing NO through a solution consisting practically only of N_2O_4, thus giving a source of error sufficient to invalidate their conclusions, and the accuracy of the analytical methods employed is also called in question. The author states that his own researches were conducted with nearly pure N_2O_3, which only partially and with difficulty combined with free oxygen present in large excess to form N_2O_4. This, together with his statement that the gases escaping from vitriol chambers under normal conditions contain a large excess of free oxygen, although the nitrogen compounds are present only as N_2O_3, form his main argument for his own conclusions.—G. H. B.

On the Reaction between Nitric Oxide and Oxygen under Varying Conditions. G. Lunge. J. Chem. Soc. (Trans.), 1885, 465.

In order to bring further facts to bear upon a controversy carried on by the author in a preceding paper, some experiments are described from which he formulates the following conclusions :—1. In the dry state, nitric oxide with an excess of oxygen combines to form N_2O_4 exclusively, or nearly so. 2. Dry nitric oxide and oxygen, with an excess of the former, yield a great deal of N_2O_3 along with N_2O_4, both in the state of gas. 3. In the presence of water, nitric oxide, with an excess of oxygen, is altogether converted into HNO_3. 4. If nitric oxide and oxygen meet in the presence of concentrated sulphuric acid, there is neither N_2O_4 nor HNO_3 formed even with the greatest excess of oxygen, but the reaction is $2SO_4H_2 + 2NO + O = 2SO_2(OH)(ONO) + H_2O$. Further, it is not NO, but N_2O_3, which acts as carrier of the oxygen in the vitriol-chamber process. An addendum contains a reply to a criticism made at the reading of the paper, in which the author contends that in the gaseous state the N_2O_3 once formed is not oxidised by any excess of free oxygen, the same for the liquid N_2O_3 having been shown by other observers.—G. H. B.

On some Sulphur Compounds of Calcium. V. H. Veley. J. Chem. Soc. (Trans.), 1885, 478.

After a historical retrospect of work done by others in the same field, the author describes in detail his experiments on the reactions of sulphuretted hydrogen over carbon disulphide upon lime, both in the dry and wet way. Careful elimination of impurities in the materials and precautions against outside influences are described, and the numerical results show a close accordance with the conclusions drawn. The author observed that perfectly-dry calcium oxide was unaltered by perfectly-dry hydrogen sulphide, and the main points of his paper he summarises as follows :—1. By the action of hydrogen sulphide on solid calcium hydroxide there is formed a calcium monosulphide in accordance with the equation—

$$Ca(OH)_2 + H_2S = CaS + H_2O.$$

2. By the action of hydrogen sulphide on calcium hydroxide in aqueous solution there is formed calcium hydrosulphide in accordance with the equation—

$$Ca(OH)_2 + H_2S + xAq = Ca(SH)_2 + 2OH_2 + xAq.$$

3. Calcium hydroxyhydrosulphide CaSH·OH absorbs carbon disulphide with formation of unstable basic calcium thiocarbonates, decomposed slowly by hydrogen sulphide, and readily by carbonic anhydride.—G. H. B.

Action of Ammonia on Solutions of Potassium Salts. H. Girand. Chem. Centr. **16**, 529 and 530.

Most potassium salts are less soluble in water saturated with ammonia, than in pure water. Some salts—*e.g.*, sulphate, oxalate, ferrocyanide and phosphate—are partially precipitated when ammonia gas is passed into their saturated solutions. The chloride, nitrate, and chlorate are not so precipitated. When ammonia gas is passed into a very concentrated solution of potassium carbonate, no precipitate is formed, but the liquid separates into two layers, of which the upper contains the greater part of the ammonia, and the lower nearly all the carbonate. When strong ammonia solution is added to dry potassium carbonate, two layers are formed and a large quantity of ammonia is evolved. A saturated solution of potassium carbonate is not miscible with strong ammonia solution until a few drops of water be added. The volume of the two layers varies with the temperature. This can be more easily seen by colouring the upper layer violet with orseille red, which has no action on the lower layer. 29° C. appears to be a critical temperature, above which the two layers unite. On cooling below this temperature the liquid first becomes turbid, and then gradually separates into two layers. Potassium sulphate is the least soluble of all the potassium salts in aqueous ammonia. The author has determined the solubility of potassium sulphate in water containing different amounts of ammonia, and from his data a curve can be constructed. Both ammonium and sodium sulphates are easily soluble in aqueous ammonia, so that a solution of sodium or ammonium sulphate in saturated ammonia solution gives, with solutions of a potassium salt in saturated ammonia solution, a precipitate of potassium sulphate. Weak solutions of potassium salts which give precipitates neither with sodium bitartrate nor with platinic chloride (without the addition of alcohol), are easily thrown down if the solution be first saturated with ammonia and an ammoniacal solution of sodium sulphate added. This reaction cannot, however, be used quantitatively.—S. R.

Sodium Hypochlorite. Egmont Kutschera. Mitth. des Techn. Gewerbe-Museums in Wien, May, 1885.

In a paper on Bleaching according to Thompson's Process, in the *Centralblatt Textil-Ind.*, November, 1884, it is stated that in decomposing bleaching powder with sodium carbonate in order to obtain sodium hypochlorite, half the bleaching power of the chloride of lime is lost. This statement is incorrect, as shown by the following equations, the accuracy of which the author has confirmed by actual experiment :—

1. $CaCl_2O + H_2SO_4 = CaSO_4 + H_2O + Cl_2$.
2. $CaCl_2O + Na_2CO_3 = CaCO_3 + NaCl + NaClO$.
3. $NaCl + NaClO_3 + H_2SO_4 = Na_2SO_4 + H_2O + Cl_2$.

The first equation shows that one molecule of chloride of lime liberates one molecule of chlorine on treatment with an acid, the second equation expresses the change which takes place when bleaching powder is decomposed by sodium carbonate, whilst the last equation shows that on treating sodium chloride and sodium hypochlorite with an acid the same amount of active chlorine is liberated as is evolved by the bleaching powder from which these salts were originally produced.—D. B.

A Convenient Process for Preparing Tetrathionates of Alkalis. N. Klobukow. Ber. **18**, 1869.

The process depends on the well-known reaction—$2Na_2S_2O_3 + 2I = Na_2S_4O_6 + 2NaI$. Finely-powdered iodine and the thiosulphate of an alkali are put in a basin containing a small amount of water, and the mixture is stirred until solution is effected. Iodine must be present in slight excess. The syrupy solution is then

poured into a flask, partially filled with alcohol, when a copious white crystalline precipitate of the tetrathionate is at once formed. After two to three hours the latter is collected, washed with alcohol, dissolved in lukewarm water, and, after adding alcohol, allowed to crystallise over sulphuric acid in vacuo.—S. H.

Improvements in the Manufacture of Chromates of Soda, and in relation thereto. E. P. Potter and W. H. Higgin, Bolton. Eng. Pat. 3229, June 29, 1883.

CHROME ore is furnaced with lime and sodium sulphate The resulting material is lixiviated with water, and the liquor obtained is treated with hydrochloric acid until it is exactly neutral, when silica and alumina are precipitated. The purified solution is then boiled down. Sodium chloride and sulphate are thrown out in the crystalline form, removed by fishing and washed with neutralised vat liquor. The strong chromate solution remaining in the pan after filtering is boiled down to dryness, and the salt perfectly dried but not fused. By this process a bichromate of soda is obtained, which also contains monochromate. If pure bichromate be required, the purified vat liquor after removal of alumina and silica is treated with a further quantity of acid in exactly the quantity required to convert the whole of the monochromate into bichromate. —S. H.

Improvements in the Process of Manufacturing Ammonia. A. Feldmann, Bremen. Eng. Pat. 11,711, August 27, 1884.

THE presence of lime mud in manufacturing liquid ammonia according to the usual methods considerably impedes the complete expulsion of the ammonia. The patentee, therefore, eliminates the insoluble lime compounds before distilling either by a filter-press or a centrifugal apparatus, and then proceeds in the usual manner.—S. H.

Improvements in the Purification of Bicarbonate of Soda and Apparatus therefor. H. Gaskell, Widnes. Eng. Pat. 11,775, August 29, 1884.

THE invention relates to the purification of bicarbonate of soda made by the ammonia-soda process, which is always contaminated with ammonia. In order to expel the ammonia by volatilisation without decomposing at the same time the bicarbonate of soda, the mixture of both compounds is heated in an atmosphere of carbonic dioxide. The patentee devised a special apparatus for this purpose.—S. H.

Improvements in the Treatment of Certain Phosphatic Materials. H. Brunner, Widnes. Eng. Pat. 12,718, September 23, 1884.

SUPERPHOSPHATES made from phosphatic materials containing lead, copper, manganese iron, or alumina, in conjunction with calcium and magnesium compounds, are apt to "go back," that is, the phosphoric acid becomes again partially insoluble in water. The present invention is designed to prevent this reversion by separating the foreign bases. The finely-ground material is treated with hydrochloric acid, to convert into chloride all the calcium and magnesium present. A concentrated solution of calcium chloride is then added, in such quantity that not less than three equivalents of calcium or magnesium chloride are present to each equivalent of phosphoric acid. The mixture is then dried, calcined and roasted. Hydrochloric acid is evolved and condensed for after use. The mass after cooling is lixiviated with dilute hydrochloric acid and copper or lead, precipitated with sulphuretted hydrogen. Should the solution contain iron or aluminium phosphate in any considerable quantity owing to imperfect roasting, it may be removed therefrom by digesting the solution with precipitated di- or tri-calcium phosphate, which latter goes into solution, while iron and aluminium phosphate is precipitated. The calcium or magnesium phosphate in solution is precipitated by the addition of lime, and the remaining calcium chloride solution may be concentrated to be used in treating a fresh quantity of crude phosphates.—S. H.

Improvements in the Manufacture of Chromic Acid or Trioxide of Chromium. W. A. Rowell, Newcastle-on-Tyne. Eng. Pat. 12,834, September 26, 1884.

THE reaction depends on the decomposition of barium and strontium chromate by sulphuric acid. It is carried out as follows:—Strontium chromate is prepared by mutual decomposition of strontium chloride and a neutral chromate. The supernatant liquor containing some strontium chromate in solution is treated with barium chloride, whereby all chromic acid is precipitated as barium chromate. The latter is then treated with hot dilute sulphuric acid in large excess, sulphate of baryta being formed, whereas chromic and sulphuric acid remain in solution. The mixture of the two acids having been separated from barium sulphate, is treated hot with an amount of strontium chromate equivalent to the free sulphuric acid present. This results in the formation of chromic acid in solution, and the precipitation of strontium sulphate. After separating the latter from the chromic acid, the solution is boiled down to dryness at a low heat. Chromate of strontium being completely decomposed by an equivalent of sulphuric acid, this process yields directly chromic acid which is free from sulphuric acid. In place of evaporating the solution of chromic acid to dryness, it may be concentrated to a considerable strength, and then precipitated by the addition of strong sulphuric acid, the mother-liquor being afterwards used for the decomposition of a fresh quantity of chromate of strontium.—S. H.

The Preparation of Chlorine Gas. J. Taylor, Cheltenham. Eng. Pat. 13,025, October, 1884.

HYDROCHLORIC-ACID gas, direct from the salt-cake furnace, is passed through a tower containing fragments of pumice-stone or coke, which is kept moistened by cold strong nitric acid. Chlorine, nitrosyl-chloride, water, and small quantities of nitrogen tri- and tetr-oxides, are thus formed. The mixed gases are passed into sulphuric acid, which absorbs the nitrous fumes, permits the chlorine to pass unchanged, and decomposes nitrosyl-chloride with the formation of hydrochloric-acid gas and nitrosulphonic acid. The reformed hydrochloric gas, along with the chlorine with which it is mixed, is a second time submitted to the action of nitric acid, and the gaseous products brought in contact with sulphuric acid. The resulting gas is put through the process a third time, and oftener, if required, until it is found to consist almost entirely of free chlorine. The nitrosulphuric acid formed in the process is decomposed by the gradual addition of water, whilst a rapid current of air is passed through the liquid. The nitrous vapours evolved are passed into water, whereby nitric acid is recovered, and by distilling the residual liquid containing a little nitric acid, that nitric acid is obtained, whilst the sulphuric acid is restored to its original condition.—S. H.

Improvements in the Manufacture of Algin and other Useful Products from Seaweeds. E. C. C. Stanford, Dalmuir, County of Dumbarton, N.B. Eng. Pat. 13,433, October 11, 1884.

IN this invention improvements are proposed in the process described in Eng. Pat. 142, 1881, and consist in directly treating fresh or dried seaweed according to the "Wet Process," described in this Journal, iv. 518. The cellulose left behind having certain peculiarities, the inventor terms it Algulose. The clear solution is precipitated by dilute sulphuric or hydrochloric acid, and the crude alginic acid thereby obtained as a precipitate is washed and pressed into cakes, which are stored in a warm room where they become air-dry. The filtrate from the alginic acid is neutralised with dolly or limestone dust, the sulphate of lime precipitate

allowed to settle, and the clear solution concentrated, to allow the sulphate of soda or chloride of sodium to crystallise out. The mother-liquor is next evaporated to dryness, and the residue is carbonised to form what is called kelp extract or kelp substitute, for the preparation of iodine and potash salts. Compared with the kelp of commerce, it contains nearly double the amount of salts, and more than double the amount of iodine, and is worth more than double the ordinary market price. The iodine and bromine may be directly precipitated by adding a copper salt. The iodine may be removed by setting it free by means of nitro-sulphuric acid or chlorine, and filtering it through charcoal or by distilling it off, if it be desired to remove it first. The alginates of the alkalis and alkaline earths can be used for stiffening woven fabrics and as mordants. The blue precipitate of alginate of copper formed by precipitating a soluble algin with a copper salt is soluble in ammonia, and becomes insoluble on drying, so that it may be used for waterproofing canvas or paper. The calcium, barium and strontium salts form useful white compounds, resembling bone, which when dry may be polished and turned. A combination of alginate of ammonia with shellac forms a tough flexible substance like gutta-percha, and is capable of replacing it in some of its applications. Further details of the properties and applications of algin will be found in this Journal, vol. iii. pp. 297—302, and iv. pp. 518—520.—A. W.

Improvements in the Manufacture of Sulphide of Zinc, and of Hydrate or other Salts of Baryta or Strontia. H. Knight, Liverpool. Eng. Pat. 16,220, December 18, 1884.

BARIUM or strontium sulphide is precipitated with an equivalent quantity of zinc chloride. After decantation from the precipitate of zinc sulphide, the filtrate is decomposed with caustic soda or potash, whereby barium and strontium hydrate is formed, which crystallises out on cooling. If other salts of baryta or strontia be required, their respective zinc compounds are employed for precipitation.—S. H.

Improvements in the Recovery of Ammonia in the Manufacture of Carbonate of Soda by the Ammonia Process, with Production of Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 1937, February 12, 1885.

THE residuary ammonium-chloride solution from the ammonia-soda process is heated with alkali waste in a closed vessel, whereby ammonium sulphide is given off. This vapour is brought in contact with a solution of ammonium bisulphate. Neutral ammonium sulphate is formed with evolution of sulphuretted hydrogen. After boiling down to dryness the solution of ammonium sulphate, the dry sulphate is heated to about 800° F., when it parts with a portion of its ammonia, which latter is absorbed in brine and used for the production of sodium carbonate, while the acid sulphate of ammonia which is left behind is dissolved in water and treated with a further quantity of ammonium sulphide as described above. The sulphuretted hydrogen may be employed for the manufacture of very pure oil of vitriol. In order to facilitate the liberation of ammonia from ammonium sulphate, the heating is carried out either in an atmosphere of steam or by adding to the ammonium-sulphate solution before boiling down the sulphate of an alkali, which will form an acid sulphate or bisulphate, preferably sulphate of potash. This alkaline sulphate serves merely to absorb the acid given off from the bisulphate of ammonia, and can be used repeatedly.—S. H.

Improvement in the Manufacture of Bichromate of Potash. P. Roemer. Elberfeld. Eng. Pat. 7135, June 11, 1885.

SODIUM bichromate is dissolved in boiling water to a concentrated solution and potassium chloride added. The whole is then maintained at the boiling point for some time. By this treatment a mutual decomposition takes place, potassium bichromate and sodium chloride being formed. On cooling, potassium bichromate separates out. The mother-liquor is concentrated so that sodium chloride is salted out, which is removed and washed with hot water. Instead of bichromate, the neutral chromate of sodium may be employed. In this case the solution is first sufficiently acidulated with hydrochloric acid to be transformed into bichromate, when the latter is treated as described.—S. H.

An Improved Method or Process for the Manufacture of Carbonate of Soda or Soda-ash. H. H. Lake. From Kayser, Young & Williams, Buffalo, U.S. Eng. Pat. 7355, June 16, 1885.

THE said invention is based on the discovery that sulphate of soda, when exposed at a low red-heat to a current of carbon monoxide in the presence of a sufficient volume of carbon dioxide, is decomposed and converted into carbonate of soda, while the sulphur is driven off in the form of sulphurous acid. Sulphate of soda is prepared by the Hargreaves' process, and used in this process without removing the sulphate from the cylinders; a mixture of one equivalent of carbon monoxide, and one of carbon dioxide, is drawn by a fan through the apparatus, whereby the sulphate is converted into carbonate of soda, sulphurous acid gas being liberated, which is employed for making new quantities of sulphate of soda.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Manufacture of Pottery. H. M. Robinson, Mintons Limited, and Leon Arnoux, Stoke-on-Trent. Eng. Pat. 12,081, September 6, 1884.

THIS invention is for the use of compressed air in equalising the pressure during the manipulation of plastic materials in moulds or on them, and for machinery for producing such plastic materials. An incidental advantage is claimed when compression is used internally to the mould, of expelling the moisture and preventing the falling in of delicate and thin work.—T.

X.—METALLURGY, MINING, Etc.

Slag from Thomas's Dephosphorising Process. C. Scheibler. Bied. Centr. **13**, 411.

THE slag is prepared for the extraction from it of earthy phosphates and ferric oxide rich in manganese, by being roasted and then submitted to the action of water or steam. In consequence of the formation of calcium hydrate, the fragments of roasted slag fall to a very fine powder.—E. G. C.

Removing Mercurial Stains from Gold. B. Fischer. Pharm. Centr. 26, 187.

MERCURY can be removed from gold articles by a wet process, consisting in rubbing them first with a paste consisting of powdered iodine and alcohol, and then adding a concentrated solution of potassium iodide. The mercury iodide at first formed on the gold is dissolved by the potassium iodide solution. The gold is unacted upon at ordinary temperatures, and can afterwards be polished in the usual way.—S. R.

The Selective Alteration of the Constituents of Cast Iron. T. Turner. J. Chem. Soc. (Trans.), 1885, 474.

THE experiments described were undertaken with a view of diminishing the amount of manganese, but of leaving the silicon, if possible, unaltered, in a sample of siliceous cast iron, by exposing it in a molten state to the action of acid and basic slag. Sand and ferric oxide were employed in different proportions to furnish the different kinds of slag. It was found that but little alteration was produced by the action of sand alone, or mixed with ferric oxide, but with ferric oxide alone a marked altera-

tion in the desired direction was obtained, and still more so by the action of an air-blast. But the alteration extended generally to the other constituents of the cast iron, and the author states that "these experiments tend to confirm the practice of the present day, as showing that when it is desired to selectively alter the constituents of iron or steel it must be effected, not by attempting to eliminate some obnoxious material, which can only be accomplished by seriously altering the amounts of other elements present, but it must be done by starting from a pure metal, and adding the constituent or constituents which are desired."—G. H. B.

An Enamel for Metals. Pol. Notizbl. 40, 125.

A MIXTURE of 12 parts borax, 20 parts soda, and 125 parts of flint glass is fused, poured on a cold plate, pulverised, and the powder mixed with a solution of soluble glass of 50° B. The metal is coated with this paste, and then heated gently in an oven until the coating is fused, and is then allowed to cool. It adheres firmly to all kinds of iron articles.—S. R.

Blum's Patent Method for the Recovery of Phosphoric Acid in Thomas's Steel Process. Berg. und Hütt. Zeit. 44, 225—226.

IN this method calcined sodium carbonate, free from sulphur, is substituted for the lime lining of the Thomas process, and in the proportion of 5·13 parts of soda to 1 part of phosphorus, and 7·85 parts to 1 part of silicon present in the iron. The soda is first put in the converter and in a fused state, and then the pig iron is introduced, and the blast is turned on and kept going until the phosphorus is removed; the converter is tipped, and the slag then poured out into an iron waggon. The slag contains, in addition to sodium phosphate and silicate, iron and manganese oxides, lime, magnesia and sulphur, and can be used as a manure, or the phosphate of soda can be extracted with cold water, the soluble glass with hot water, and the residue used for the preparation of ferro-manganese. At Creuzot, with a grey iron rich in silicon, lime is added to combine with the silica, and afterwards soda to unite with the phosphoric acid. From the Creuzot slag water extracts a large quantity of sodium vanadate, which was lost by the old process.—S. R.

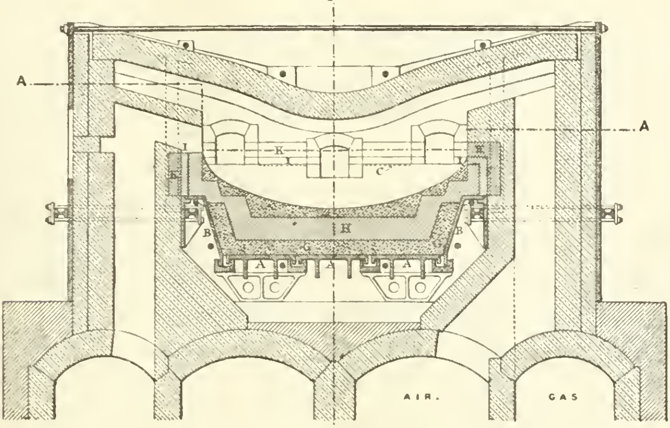
Gold in the North of Japan. R. J. Frecheville. Proc. Inst. C.E. vol. 75.

IN the northern part of Hondo, a number of small veins, enclosed in a porphyritic rock, have been worked for gold from time immemorial at the Okudzu Mines. The veins average about one foot in width, and are filled with quartz and decomposed country rock, carrying disseminated crystals and thin bands of copper and iron pyrites, together with small quantities of zinc blende and galena. The gold is extremely finely divided, and can rarely be seen without pulverising and washing the ore. About 120 tons per month of ore, containing 1½oz. of gold, were delivered at the floors at a cost of £4 per ton. The richest ore was crushed by a primitive stamp, then ground between flat stones like flour milling, but worked by hand, and the slime produced was washed over a sloping board scored with saw-cuts. The coarser portion, caught in a tub at the foot of the board, was ground again. The concentrations from the board were washed by hand in a shallow wooden dish, and the gold obtained was melted with borax and lead, and the product cupelled. About 50 per cent. of the gold was got by the first washing from ores assaying 2oz. per ton, and about 80 per cent. from the richest class of ores, which assayed 5oz. per ton and upwards. The tailings, after weathering for some time, were re-washed, yielding a further amount of gold. The author arranged a modern plant, consisting of a 10-stamp gold-mill, a slime separator "Spitz-Lutte," Rittinger's double side-blow percussion table, twelve Hungarian mills, strakes covered with scored boards to save fine gold from the slimes, and two flat-bottomed iron grinding pans. The pan-amalgamation gave 90 per cent. of the gold contained in the concentrates, and the result of the combined treatment by concentration and amalgamation was an average of 82 per cent. of the gold in the ore milled. A 40 H.P. multitubular boiler and engine, with cylinder 15in. diameter and 2½ feet stroke, supplied the power.—J. T.

Basic, Open-Hearth, Steel Process. T. Gillott. Proc. Inst. C.E. vol. 77.

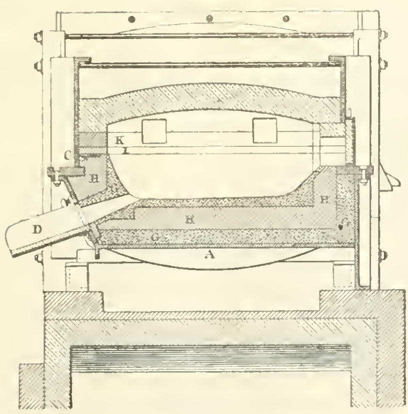
THE author made experiments, dating from May, 1882, at the Farnley Iron Company's works, near Leeds. According to Thomas and Gilchrist, pig-iron, suitable for the basic Bessemer process, should approximately contain silicon 0·5 to 1·8; phosphorus, 0·8 to 3·0; sulphur, under 0·3; manganese, not over 2·5 per cent.; and, in order to secure the necessary heat, the carbon would probably have to be 3·5 per cent.; but in the basic open-hearth process the proportion of heat-producing elements need not be high, and large quantities of wrought-iron scraps, which often contain 0·2 per cent. of phosphorus, may be converted into steel of great purity. As no basic bricks, excepting such as were too costly, were suitable for constructing the furnace throughout, the author consulted chemists as to materials which would be sufficiently refractory at a steel-melting heat, and at the same time securely isolate the dolomite lime basin of the furnace from the silica walls above. He was advised that magnesia on the lime, alumina above the magnesia, and silica brickwork carried up on the alumina, would be secure; so bricks were made from magnesite, containing 98 per cent. magnesium carbonate, and others from bauxite of the approximate composition, silica, 15; alumina, 82; lime, 1; iron sesquioxide, 2 per cent.; and with these the furnace was built in accordance with Figs. 1 to 4. This furnace had been previously used in the acid process for 50—55cwt. charges. Provision was made for the removal of the slags in the early stages of the process, so that the banks of the furnace might be preserved; and any phosphorus transferred to the slags could be withdrawn, so as to reduce the amount of purification at the later stages; this provision proved very useful. The iron bottom plates A and the bridge plates B are similar to those used for the acid furnace; brackets bolted to the side-plates of the furnace support the brickwork by the plate C at the level of the top of the lime basin, and prevent settlement of the upper brickwork in case of any shrinking of the lime basin or fluxing in work. The metal tapping hole and spout is at D, and the slag tapholes are at higher levels EE on the opposite side of the furnace. Bricks made from magnesian lime, and of the following composition—Lime, 58; magnesia, 24; silica, 8; alumina and iron oxide, 10 per cent.—are burnt at a full white heat, crushed, mixed with hot tar in a mortar mill, and are taken immediately to the furnace and rammed with red-hot rammers over the parts G, wooden plugs being inserted to form the tap-holes, the parts marked H being walled in the same bricks, and grouted with material similar to the ramming. The isolating courses J and K, of magnesian and bauxite bricks respectively, are laid on the top of the brackets C, and across the ends of the basin over the plates B; and the shape of the hearth is completed by lime ramming. The use of hot rammers is necessary to coke the tar; otherwise the lime swells and falls to pieces in about twenty-four hours after mixing. The upper part of the furnace is then completed in silica-brick. After about seventy-two hours' firing, the furnace is ready for forming the bottom, and for this a full melting heat is necessary. Well-burnt and freshly-ground magnesian limestone is laid over the bottom and up the sides, with not more than 10 per cent. of ground fire-brick added, so as to flux the lining sufficient for binding the layer forming the furnace bottom. The tap-holes are stopped by dry lime only, or dry lime mixed with a little powdered coke. The gas- and air-ports should be so arranged as to throw the flame well down on the bottom, so that the heat may be sufficient to allow of the smallest possible admixture of silicious flux. The operation is thus conducted: Fresh well-burnt lime, about one-twentieth to one-tenth of the weight of the pig-iron, is laid upon the bottom of the furnace, the pig is then charged, and

the wrought-iron or steel scraps are put on the top of the pig, all being cold. The whole of the charge if possible is placed in the furnace at the commencement. In three or four hours, the pig being melted, some slag can be tapped off. The first slag is generally very fluid, and more or less so as the silicon in the pig is higher or lower; consequently the sides of the hearth are preserved by getting rid of the more silicious slag before the full may be raked off through the centre door, which is placed 4½in. lower than the two end doors. About 5 per cent. of hæmatite pig is then charged through the end doors on the bridges, which pig, when melted, causes the metal to boil more or less violently for about fifteen minutes. After this fifteen to thirty minutes are allowed to elapse, and any excess of slag beyond what is required to cover the metal in the casting ladle is removed, when the



SECTION AT B.B.

Fig. 1.



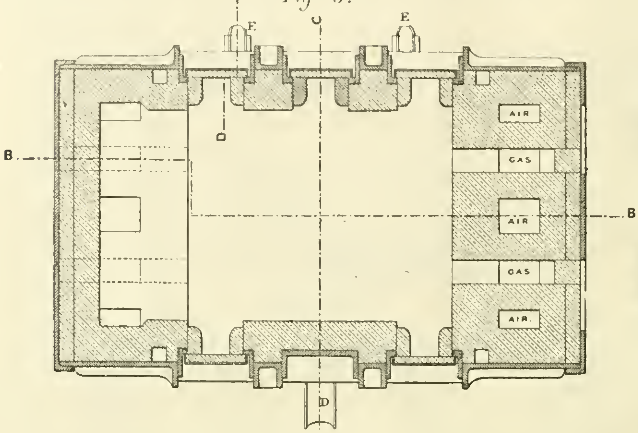
SECTION AT C.C.

Fig. 2.

heat is reached. In three-and-a-half to six hours, the time being dependent on the proportion of pig to scrap, the whole charge will be melted, more slag can be taken off if required, some lime added if the slag is very fluid, and ore with the lime of the proportion of pig to scrap is high. When the boiling has ceased, and after the bulk of fluid metal has been well stirred, the metal may be sampled. The sample being satisfactory, the pasty slag metal is ready for adding spiegel or ferro-manganese, and tapping. The addition of hæmatite pig causes a thorough agitation of the bath far beyond what can be done by stirring, and every analysis made proves a further removal of phosphorus by the addition. Occasionally, however, this after boil causes failure of parts of the hearth. Attempts to secure the quality of steel aimed at without adding pig at the end of the purifica-

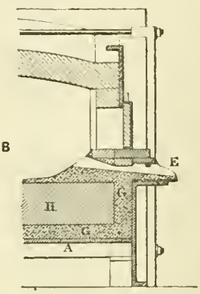
tion were made, but the results were uncertain and irregular. In only one instance has the author obtained evidence of re-phosphorisation on adding the ferro-manganese after adding hæmatite pig. In this case the sample showed 0·104 per cent. of phosphorus, while the finished steel showed 0·122 per cent. In other cases where the two respective samples were tested for phosphorus, the reduction per cent. averaged 0·016, and varied from 0·008 to 0·025 less phosphorus in the steel than the trial samples contained. Highly satisfactory results were obtained; but it may be remarked that Farnley Best Yorkshire cold-blast pig has been the only phosphoric pig used; and being so low in silicon and sulphur, regular in quality, and more free from adhering sand than the cheaper hot-blast irons, much of the success obtained must be credited to the principal raw material used. To remedy certain defects of the experimental furnace, the author has designed the furnace shown—Figs. 5 to 9—in which the gas- and air-passages are carried up outside the walls of the furnace, an arrangement patented by Hackney and Wailes. Three doors for charging and repairing, and two slag spouts are provided on the opposite side to the tap-hole for the metal, and two sight-holes LL. Owing to the very soft quality of the steel produced, the heat required is nearly as great as Sheffield silica-bricks are able to withstand; so long as the slag can be kept clear

Fig 3.



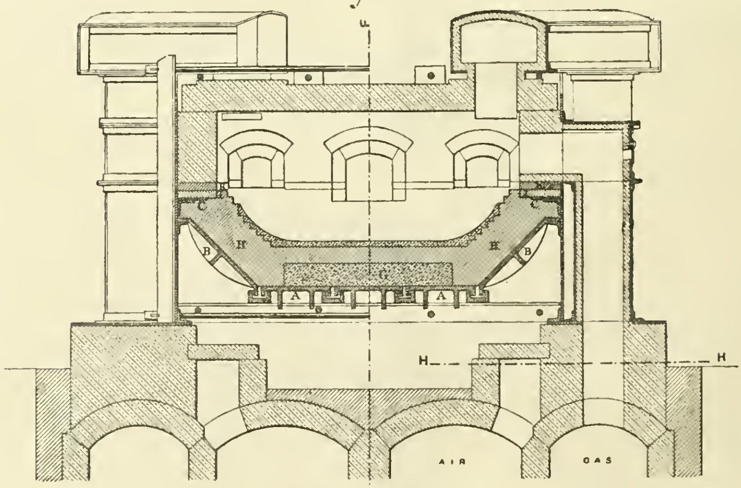
SECTION AT A.A.

Fig: 4.



SECTION AT D.D.

Fig: 5.

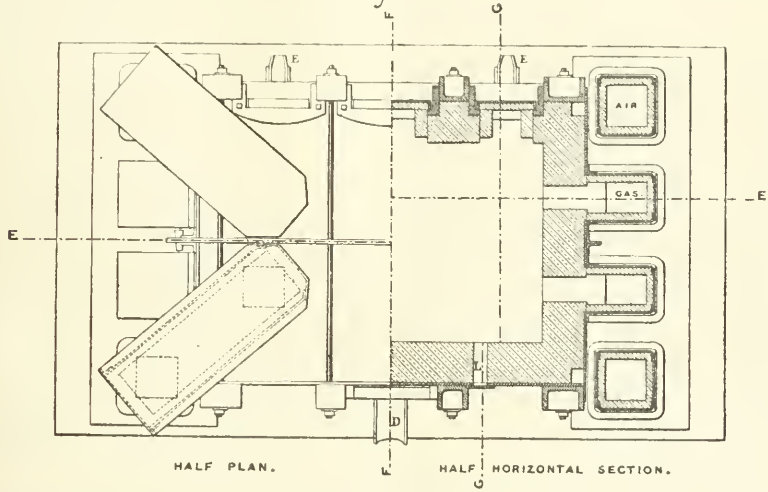


SECTION AT E.E.

of the magnesia and bauxite bricks they have been satisfactory, and, but for their great cost, magnesia bricks would doubtless be much better than silica bricks for the faces of the ports. The waste is not excessive; taking the more recent work, without charging or crediting skulls and pit-scrap, the results for the 106 casts are as follows:—Farnley pig, 90·4 tons; hæmatite pig, 9·675; iron and steel scrap, 130·15; ferro-manganese, 4·73—total, say 235 tons charged. The total weight produced, of ingots and spare metal, is 219·3 tons, or about 93 per cent. of the raw materials. About 9cwt. of raw dolomite per ton of ingots has been used for repairs of the furnace, as deduced from the work done during the year.

Numerous mechanical tests are given, the average breaking weight being 24·76 tons per square inch, with a minimum of 22·29, and a maximum of 26·68; average elongation on eight inches being 30·62 per cent., with a minimum of 25·0, and a maximum of 37·5. The order of removal of phosphorus is different from that in the Bessemer converter. In the latter process the phosphorus is not eliminated to any great extent until the carbon and silicon have almost disappeared; hence so little as 1·974 per cent. of phosphoric acid in the final slag was not expected. Another sample of slag, taken after the pig was fluid, but before the scraps were melted, was, however, found to contain 5·087 per cent.

Fig 6



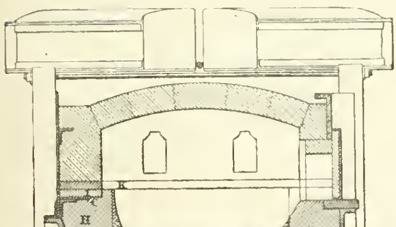
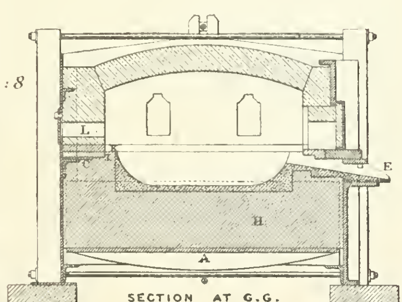


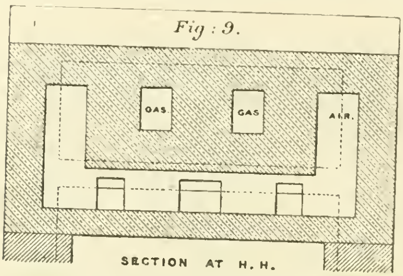
FIG. 7.

Fig: 8



of phosphoric acid. Samples of metal taken when the whole charge was melted, and before boiling commenced, have always been found to contain less phosphorus than the charge was known to contain, showing that the elimination of phosphorus commences in the early stages. Sulphur does not appear to be eliminated during the process. A sample of deposit from the gas-regenerator contained 4·741 per cent. of phosphoric acid; and another

Fig: 9.



SECTION AT H. H.

sample from the air-regenerator contained 2·995 per cent.; thus indicating that some of the phosphorus leaves the furnace otherwise than in the slags. The analyses were made by J. O. Arnold. The phosphorus was precipitated boiling by molybdate solution, and reprecipitated by magnesium mixture, giving results higher than are obtained by the molybdate method.—J. T.

Variation in the Elasticity of Iron and Steel. Chem. Centr. **16**, 574—575.

It is a well-known fact that iron obtained by puddling and welding is not homogeneous throughout, and it has been shown that blocks of Bessemer steel have towards the centre a larger percentage of carbon, silicon, sulphur, phosphorus and manganese. In many works the homogeneity of the steel is tested by the change of colour produced by change of temperature. Kerpely has shown that a cast steel obtained by melting a cementation steel of greater hardness than the standard can only serve for this test, since the stirring of the molten mass by itself produces very little effect. By heating masses of heterogeneous iron and steel similar changes take place as in the cementation process, and in the method for producing tempered steel by heating cast iron with iron oxide. A kind of internal cementation goes on which, if sufficient time be allowed, must produce a metal of greater chemical uniformity. Fibrous iron, which has been exposed to a high temperature for some time, becomes more brittle but less hard, and acquires a crystalline fracture.—S. R.

Production of Lead, Silver, and Zinc in Germany during the Year 1884. Chem. Centr. **16**, 589—590.

The total production of lead throughout the world is estimated as being between 450,000 and 500,000 tons annually. In 1884, Spain contributed 90,000 tons, and North America 139,897 tons.

PRODUCTION OF ZINC IN EUROPE.

Localities.	1884.	1883.
Rhine provinces and Westphalia	37,461	36,038
Silesia	76,238	71,466
Belgium	40,449	38,095
Altenberg Company	52,532	50,015
Asturisch Company	15,574	14,893
England	29,259	28,661
Austria	4,000	4,540
Poland	4,227	3,789
Total in Tons	259,740	247,505

—S. R.

PRODUCTION OF LEAD AND SILVER.

Localities.	Lead in Tons. 1884. Lead.	Lead in Tons. 1884. Litharge.	Lead in Tons. 1883. Lead.	Lead in Tons. 1883. Litharge.	Silver in Kilos. 1884.	Silver in Kilos. 1883.
Prussia	68,450	2,158	65,731	2,312	121,724	111,991
Hannover	10,809	1,628	10,318	1,820	47,695	12,511
Nassau	9,373	421	8,111	445	11,396½	17,333
Saxony (Freiberg)	5,469	509	5,274	458	60,309½	58,946
Total	94,101	4,713	89,767	5,044	246,925	233,884
	98,814		94,811			

Process for Electrolytic Extraction of Copper from its Ores. Eugenio Marchese, Genoa. Eng. Pat. 12,725, September 23, 1884.

A portion of the ore is smelted so as to form a matt, consisting generally of copper, iron and sulphur. This is cast into plates, to be employed as the anodes in the electrolytic baths, plates of copper being used as cathodes. Another portion of ore is roasted and lixiviated, sulphuric acid being added to dissolve the oxides. The resulting solution of the sulphates of copper and iron is charged into the electrolytic baths, where it is decomposed by the current. Metallic copper is deposited on the cathodes, and the sulphides of the anodes are dissolved. The electric current is obtained largely by the oxidation of the iron in the anodes. The spent anodes are used for the production of sulphur and sulphuric acid, and the sulphate of iron in the spent liquor is crystallised.—S. Y.

Process for the Recovery of Tin from Tinplate Scrap and other Materials containing Tin, such as Oxidised Metal and Residues. Herbert John Haddan, Strand, Westminster. From Alfred Lambotte, Brussels. Eng. Pat. 14,672, November 6, 1884.

The matter to be treated is subjected in suitable chambers to the action of chlorine gas, largely diluted with air, and heated to a temperature above the boiling point of stannic chloride. The chloride formed is suitably condensed, either by injecting steam into the gases as they leave these chambers, and collecting the crystals in condensation chambers (the dry gases may, if preferred, be led into the condensation chambers, the walls of which must then be kept moist), or by absorbing it in a solution of stannic chloride. The evaporation of the concentrated solution may be conducted without risk of decomposition by passing through it a current of warm air. Dilute chlorine, yielded in certain chemical processes, is available for this method of treatment.

—W. G. M.

A Process for Producing Aluminium from Chloride of Aluminium (Al_2Cl_6). Hector von Grousilliers, Springe, Hanover. Eng. Pat. 7858, June 29, 1885.

IN order to avoid the difficulties ordinarily met with in the use of aluminium-sodium-chloride to obtain metallic aluminium, the patentee raises the volatilising point of the simple chloride by performing the reduction, either chemical or electrolytic, under pressure in a strong hermetically closed vessel, lined with clay or magnesia, and provided with a safety valve.—W. G. M.

Improvements in Metallurgical Furnaces. John Thomson King, Liverpool. From Samuel Thomas Owens, Pittsburg, U.S. Eng. Pat. 8478, July 14, 1885.

THIS is a form of regenerative furnace, in which the heated products of combustion pass continuously in the same direction through clay pipes, supported at the joints, and laid in a chamber beneath the furnace. The air to be employed in combustion is heated by passing between these pipes into a long arched space above them; thence it flows to the fire bridge. The gas is supplied through a series of nozzles placed on a level with the top of the bridge; it may be warm, as supplied direct from the producer, or be heated by traversing pipes placed in the air space above the flue pipes already described.—W. G. M.

Improvements in Apparatus for Refining Copper and other Metallic Mattes by Electrolytic and Chemical Actions. W. Wood and M. H. Hurrell, London. Eng. Pat. 8661, July 17, 1885.

IMPROVEMENTS in apparatus for refining by electrolytic and chemical action copper and other mattes of metals, which are with difficulty, if at all, separated by the process of fusion. In a main tank, porous cells, containing the matte cast in the form of anodes, together with the cathode plates, are arranged so as to secure the upward and downward flow over their surfaces of the electrolytic solutions. There is an elevated supply tank, with distributing pipes, for supplying the solution to the main tank, and an arrangement by means of which the weak solution from the main tank is conveyed to the porous cells, and the strong solution away from the lower part of the porous cells. A chemical precipitating tank, fitted with plates, is also arranged so as to secure an upward and downward flow of the solution, and to return it from the precipitating tank to the elevated tank. A pump for raising the solution to the elevated supply tank is set in motion and stopped by the action of the return solution.—T.

Improvements in and Relating to the Purity of Iron and Steel. William Robert Lake, London. From William Henry Purdy, Brooklyn, U.S. Eng. Pat. 8819, July 21, 1885.

THE interior of the melting vessel is lined to the depth of one quarter of an inch (or the metal itself may be painted before fusion) with a mixture of minium (1lb.), litharge (1lb.), cinnabar (¼lb.), and moulding sand or loam (3lb.), with one gallon of water. The basic nature of this mixture causes it to exert a purifying action on the melted iron; whilst the excess of the oxygen of the minium removes a portion of the carbon.
—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Adulteration of Olive Oil. Arch. Pharm. **3**, 23, 280.

THE various oils commonly employed for the adulteration of olive oil may be detected as follows:—

Linseed Oil.—2cc. nitric acid are mixed with 5cc. of the sample, and a piece of bright copper wire introduced into the mixture. If after half-an-hour the wire has acquired a rose colour the olive oil contained linseed oil as an adulterant.

Cotton-seed Oil.—The olive oil is mixed with an equal quantity of nitric acid (40° B.). A brown colouration indicates the presence of cotton-seed oil.

Sesame Oil.—An equal quantity of hydrochloric acid (23° B.) is added, and a fragment of cane-sugar dissolved in the mixture. If after shaking and standing a red colour is developed, sesame oil is present.

Colza Oil.—10grm. of the oil is saponified with an alcoholic solution of caustic potash (free from sulphur); a darkening in colour shows that colza oil has been added.

Earth-nut Oil.—The oil is saponified with alcoholic potash solution, and the soap when separated is warmed to remove the alcohol. It is then decomposed with hydrochloric acid, and the liberated fatty acids dissolved in boiling alcohol. If the oil has been adulterated, arachidic acid will now separate out. It can be recognised by its mother of pearl lustre.—S. R.

Determination of the Sp. Gr. of Butter and Tallow at 100° Wolckenhaar. Rep. Anal. Chem. **5**, 236.

THE author has determined the sp. gr. of these fats by means of an areometer, and has compared the indications of the instrument with the numbers obtained by weighing a standard sinker, immersed in molten fat. The results were not concordant, and established a serious but nearly constant discrepancy between the true sp. gr. and the areometer readings; this is shown by the following numbers (mean of six determinations, probable error <0.003):—

	By Areometer. sp. gr.	By the Balance. sp. gr.
Butter	0·868	0·9025
Tallow	0·860	0·8938

—C. F. C.

Chemical Action of Soaps. Professor Rotondi, of the Royal Industrial Museum of Turin. Chem. Rev. **14**, 228.

THE author rejects the theory of Berzelius, that the usefulness of soaps depends upon the facility with which neutral soaps decompose on solution into acid soaps and free alkali, and also that of Persoz, who assumes neutral soaps to be soluble in hot water without decomposition, but to be resolved in cold water into acid and basic soaps—the latter dissolving fatty substances by saponification. These hypotheses do not explain why hot soap solutions are more active than cold ones. The following conclusions were arrived at by the author from experiments upon carefully purified Marseilles soap. Neutral soaps on solution are decomposed into basic and acid soaps, the latter are insoluble in cold, and only slightly soluble in hot water; they are not dialysable, and so are thus separable from the former, which are readily so. The neutral soaps, though thus decomposed, lose neither free nor carbonated alkali. Basic soaps are completely soluble in cold and hot water, and are entirely precipitated by sodium chloride without loss of alkali; their solutions dissolve acid soaps on heating, but become turbid on cooling. They emulsify fatty bodies readily, but no saponification of the latter takes place; neutral soaps possess this property to a smaller extent, acid soaps scarcely at all. Carbonic acid produces in cold solutions of basic soaps insoluble compounds, which, however, disappear on heating, hence waters rich in carbonic acid are not suited for industrial operations with soap. The above explains the greater efficiency of hot soap solutions, and bears importantly upon the manufacture and industrial uses of soap, inasmuch as different results are often observed in the use of soaps made from the same materials (and containing no free alkali), due to their containing variable amounts of acid and basic soaps. The author considers that soaps should consist as nearly as possible of neutral compounds, citing instances of danger attendant upon the presence of an excess of basic soap—*e.g.*, in the boiling of silks. These are facts to be borne in mind in the operations of soap-boiling, as well as in soap analysis when it is desired to ascertain the fitness of a sample for a given purpose.—E. E. B.

A New or Improved Method of, and Apparatus for the Emulsion of two Substances of Dissimilar Specific Gravity. E. G. Brewer, of London. From Burmeister and Wain's Maskin and Skibsbyggeri, Copenhagen. Eng. Pat. 11,907, September 2, 1884.

THIS invention consists in the employment of centrifugal-power machines for the production of the emulsion of some fatty substance in milk; this may be effected either with or without the simultaneous separation of cream from the milk. The fat-delivery pipes are usually led from a small reservoir arranged on the centrifugal spindle, and when the latter rotates, the fat is driven in fine streams into the milk. In some cases, however, the fat-delivery tube is stationary, and adjustable in the cover of the centrifugal reservoir, in which case its opening is more or less bent. Drawings of these various openings are given. The claim is very elaborate, and is summed up in 13 heads.—W. L. C.

Improvement in the Manufacture of Soap. Clem. Harrison, East Dulwich. Eng. Pat. 12,841, September 26, 1884.

To increase the detergent qualities of soap, turps, ammonia, and pearlash, in suitable proportions (none are given) with or without the addition of methylated spirit, are incorporated either with soap, or with fats and oils prior to their saponification.—W. L. C.

A New or Improved Process for Obtaining useful Products from the Yolk or Grease of Wool. W. H. Beck. From C. Viollette, of Lille, and A. Vinchon, of Roubaix. Eng. Pat. 13,815, October 18, 1884.

THE perfectly dried yolk is heated in a boiler to 250° or 300° (whether C. or F. is not stated) for some hours with one-fourth its weight of solid caustic soda, the mass being agitated by mechanical stirrers. The free fatty acids are thus saponified, and the neutral ethers are decomposed; the alcohols also are transformed into their corresponding acids, for example cerylic alcohol into cerotic acid. When the reactions are completed the mass is treated with three or four times its weight of boiling water, after which the soda solution thus formed is concentrated and calcined, while the soaps are decomposed with a mineral acid, and the resulting fatty acids, which are specially waxy in character, are distilled in superheated steam. Soda-lime, or potash-lime, may be substituted for the caustic soda. It is claimed that the solid fatty acids are more than 50 per cent. of the primary material employed, and that the process resolves satisfactorily the question of the purification of wash waters from wool.—W. L. C.

Improvements in the Process of Manufacturing Railway Axle-, or other Grease, and in Plant or Apparatus applicable therefor. M. W. Hydes and J. H. Williams. Eng. Pat., December 16, 1884.

THIS contains solely the description of a jacketed pan, graduated to show the contents at a given height, fitted with superheated and ordinary steam, run-off cocks, reservoirs, etc. To render control of the operations easy, the cocks of the various pipes are all brought to one dial plate. A drawing is given, but no process of manufacture is described.—W. L. C.

An Improved Compound for Cleansing Wool and other Fibres, Cloth, and other Fabrics. James Hanford, Leeds. Eng. Pat. 7004, June 9, 1885.

LARD, resin, and American potash are incorporated and allowed to stand for some days, after which silicate of soda, soda-ash, soft soap, Irish moss, and farina, are added; the whole is boiled for two hours, and after straining and cooling is ready for use. The proportions of ingredients necessary for 25cwt. of the compound are named.—W. L. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

A Blackening for Leather Articles. Chem. Centr.-Blatt. **16**, 543.

THE following receipt gives a black which will take a good polish, and can be used for any kind of leather:—To 3lb. of boiling water are added ½lb. of white wax, 1oz. transparent gelatine, 2oz. gum senegal, 1½oz. white soap, and 2oz. brown sugar; when the mixture is cold 2½oz. of alcohol and 3oz. of Frankfort black are added. It is applied to the leather with a soft brush, and when dry the leather is rubbed with pumice stone and finally polished.—S. R.

XIV.—AGRICULTURE, MANURES, Etc.

On the Yield of Alkaloids from Different Species and Varieties of Lupin. E. Hiller (Landwirthsch. Vers.-Stat. **31**, 336—341).

THE following table contains the results of analyses by the author, and by E. Täuber (*Ibid.* 29, 451):—

	E. Hiller.			E. Tauber.		
	Total Alkaloids.	Liquid Alkaloids.	Solid Alkaloids.	Total Alkaloids.	Liquid Alkaloids.	Solid Alkaloids.
Lupinus luteus	0·65	0·32	0·33	0·81	0·39	0·42
Yellow flowering lupin (bastard)	0·55	0·32	0·23	0·70	0·29	0·41
Lupinus albus	0·15	0·025	0·125	0·51	0·08	0·43
,, termis	0·35	0·032	0·318	0·39	0·03	0·36
White flowering lupin with large seeds	0·27	0·017	0·253	0·27	0·015	0·255
Lupinus linifolius	0·21	0·027	0·213	0·32	0·02	0·30
Blue flowering lupin with white seed	0·23	0·029	0·200	0·37	0·02	0·35
Blue lupin	0·21	0·024	0·186	0·29	0·05	0·24
Lupinus augustifolius	0·21	0·014	0·196	0·25	0·03	0·22
,, hirsutus	0·01	—	0·010	0·02	—	0·02

—S. Y.

Soils and Peats from the Baltic Region. Prof. G. Thoms, Baltisch. Wochenschr. 1883-4, Bied. Centr. **13**, 1884, 410.

THIRTY-NINE samples (of loam, marl, and other soils) contained proportions of phosphoric acid ranging from

0·02 per cent. to 0·19 per cent., the mean being 0·0763 per cent. Thirty-six samples of moorland soil were found to contain the following proportions of mineral matter, nitrogen, potash, and phosphoric acid:—

	Mineral Matter.	In the Ash.		In the Dried Soil.		
		Potash.	Phosphoric Acid.	Potash.	Phosphoric Acid.	Nitrogen.
Maximum	32·87	0·89	1·03	0·1602	0·5671	5·81
Minimum	0·95	0·17	1·28	0·0010	0·0225	0·86
Mean	7·62	0·31	2·02	0·0370	0·1115	2·36

—E. G. C.

A Sample of Cave Earth. Prof. J. König. Bied. Centr. **13**, 410.

This earth came from a cavern in the neighbourhood of Clusenstein, and contained bones, greatly weathered, together with large stones. The composition of the sample was as follows:—

	Cave Earth.	Bones Therein.	White Stones Therein.
Water	15·51	11·88	31·07
Organic matter	3·02	9·66	0·91
Nitrogen	small quantity	1·19	—
Mineral matter	81·17	78·16	67·99
In latter:—			0·49
Phosphoric acid	4·24	25·16	
Lime	1·76	31·00	38·16
Equivalent to:—			1·07
Calcium phosphate	9·26	54·92	
Calcium carbonate	—	2·35	66·80

—E. G. C.

A New Cattle Food. H. Gilbert. Bied. Centr. **13**, 1884.

This article was sold under the names of "strength food," and "palm-nut meal," and it was found by the author to consist of 12 per cent. of common salt, and 88 per cent. of vegetable ivory turnings. These were a waste product from the manufacture of buttons, and their nutritive value was very trifling, because of their horny character. The results of the analysis were as follows:—

		Control-analysis of some v. i. turnings.
Fat	1·05	1·02
Proteïds	4·19	4·81
Ash (including 11·51% of salt)	13·61	1·46
Woody fibre	10·33	13·61
Water	9·20	10·50
Non-nitrogenous extractive matter	61·37	68·60
	100·00	100·60

This cattle food was not pulverulent, like palm-nut meal, but contained little white and brown particles, which could be separated from the salt by treatment with water. The nuts known as vegetable ivory come from a kind of palm *(phytelephas macrocarpa)*, and are imported from Columbia and Ecuador. Dr. J. Moeller states that the horny matter of which these nuts are composed consists of a peculiar modification of cellular tissue, scarcely to be distinguished from pure cellulose. Other examples of this compact horny structure are to be found in the date-stone and the coffee-berry.—E. G. C.

Treatment of Human Excreta for Manurial Purposes. K. Engler. Bied. Centr. **13**, 411.

According to the process of Buhl and Keller, carried out in Freiburg, ammonia is separated from the sewage by distillation with milk of lime, and the solid matters are precipitated by a manganese solution. The "poudrette" contains from 2·1 to 3·0 per cent. of nitrogen (calculated on the dry substance), while 1,000 parts of the waste water contain from $12\frac{1}{2}$ to $15\frac{1}{2}$ parts of solid matter, of which from 3·2 to 4·7 parts are lost on ignition, together with 0·2 part of ammonia. This waste water is allowed to run into pits, but no indications of contamination of the water of neighbouring wells have yet been observed. —E. G. C.

The Manuring of Hops. E. Pott. Bied. Centr. **13**, 412.

The author considers that the manures commonly used, such as stable-manure, refuse from latrines, etc., have a tendency to increase the quantity of hops yielded, at the expense of their quality. Hops should not be over-manured, and manures rich in nitrogen should be especially avoided. From 3 to 6kilos. of bone meal, with $1\frac{1}{2}$ to 2kilos. of Chili saltpetre, to the square metre, in soils poor in phosphoric acid, or from 6 to 15kilos. of crude potassium chloride, with or without Chili saltpetre, on land poor in potash, would furnish satisfactory results.—E. G. C.

Bavarian Peat. Th. Schreiber. Bied. Centr. **13**, 418.

The results of analyses of 27 samples of Bavarian peat are given in this paper, the percentage proportions of fibre, dust, mineral and organic matter, and nitrogen, being stated. It appears that Bavarian peat is richer in nitrogen than North German peat.—E. G. C.

On the Absorption of Nitrogen by the Leguminosæ. Boutellau. Bied. Centr. **13**, 420.

A PLOT of land, previously a vineyard, was manured with 800 to 900kilos. of superphosphate, and sown with oats in the autumn. In the following spring, the field received a top-dressing of 150kilos. of Chili saltpetre, and was then sown with lucerne and esparsette, among the grain: 45 hectolitres of the latter were reaped in August. In the next autumn the plot was treated with 800 to 900kilos. of a manure containing 14 per cent. of potash and 6 per cent. of phosphoric acid, which was exclusively employed during the following year. The yield of dry fodder from the three annual reapings amounted to 14–15,000kilos. From whence did these considerable crops derive their nitrogen? For, the author observes, the one manuring with Chili saltpetre was absorbed by the crop of grain, other experiments having shown that the soil was not in a condition, without manuring with nitrogen, to yield good grain crops; and yet the leguminosæ flourished well. Another field was treated with 35,000kilos. of stable-manure, and then planted, one-third with potatoes, one-third with maize, and one-third with vetches. Next year the whole field was sown with wheat, the portion where potatoes had grown yielded 30 hectolitres, the plot previously covered with maize yielded 28 hectolitres, and the part where the vetches had been furnished 35 hectolitres. The vetches contained more nitrogen than the maize, and yet the wheat crop was more abundant after the vetches than after the maize.—E. G. C.

On the Separation of Oxygen in the Leaves of the Crassulaceæ. Adolph Mayer. Bied. Centr. **13**, 422.

SOME previous investigations of the author appeared to indicate that leaves of the crassulaceæ, exposed to the light in an atmosphere free from carbonic anhydride, separate oxygen gas, and lose their acidity. This acidity was considered by the author to be due to a modification of malic acid, called by him iso-malic acid, and which he thought might be converted, by a process of reduction, into a carbohydrate. The results of further experiments have served to support the accuracy of these conclusions, an increase in saccharine and starchy matter having been observed by A. Mayer in the leaves after exposure.

—E. G. C.

On some Points in the Composition of Soils, with Results illustrating the Sources of Fertility of Manitoba Prairie Soils. J. B. Lawes and J. H. Gilbert. J. Chem. Soc. (Trans.) 1885, 380—422.

THE present communication is a continuation of a previous paper relating to the sources of nitrogen of our crops (*J. Chem. Soc.* (abstr.), 1884, 682—691), wherein are set forth and discussed the results of the determinations of nitrogen in various experimental crops, and in the upper layers of the soil upon which they were cultivated. In that paper the authors show, amongst other things, that the annual yield of nitrogen is least in cereals, greater in roots, and still greater in leguminous crops, whilst with rotation, when roots and leguminous crops are interpolated with cereals, the yield is greater than with cereals continuously grown; but whenever the same crop is grown year after year on the same land without manure, or with mineral (non-nitrogenous) manure only, in all cases, and with all crops on arable land, there is a great decrease in the annual yield of nitrogen, and in most cases this is accompanied by a simultaneous decline in the quantity of nitrogen in the surface soil. This is especially evident in cereal and root crops; in fact, almost all their nitrogen may be traced to the deficit in the soil. With leguminosæ grown occasionally on arable soil, however, the reverse is sometimes the case, and the surface soil is found richer in nitrogen after, than it was before the crop was grown; hence, cereals thrive well on land after clover. But experiments with leguminosæ grown continuously on the same garden soil, indicate that they follow the above rule, and each successive year the nitrogen, both in soil and in crop, becomes less; in fact, almost all the nitrogen in the crop can be accounted for by the loss of nitrogen in the first eighteen inches of soil, and the small quantity supplied in rain, etc. Mixed herbage on permanent grass land yields more nitrogen per acre per annum when manured with mineral (non-nitrogenous) manure, than when it receives no manure, and this increase is found to be more than counterbalanced by a loss of nitrogen in the soil. Strong, deeply-rooted plants (*melilotus leucantha*) have yielded large quantities of nitrogen, when similar but weaker plants (*trifolium repens*) have failed to thrive, the soil was found much less moist in the former than in the latter case. Taking these facts into consideration, coupled with the fact, as the authors point out, that the quantity of combined nitrogen supplied from the atmosphere in rain, dew, and all other forms is quite inadequate for the requirements of plants; and as, moreover, the balance of experimental evidence is against the supposition that plants assimilate free nitrogen from the atmosphere, they conclude that the store of nitrogen in the soil is the source of at least most of the nitrogen in the plants. Whilst in this and other papers it is shown that much of the nitrogen derived from the soil is taken up as nitrate.

These investigations have now been extended to other soils and to sub-soils; the above results relating principally to surface soils. Towards the end of July, 1883, after the crops were removed, soil samples were taken to the depth of twelve times nine inches, from plots of common vetch (*vicia sativa*) from plots of white clover (*trifolium repens*), and from wheat and fallow land, which had been fallow since the previous harvest. These plots were all in the same field, quite close together. A fairly luxuriant crop has been taken off the vetch plots, but there was no plant at all on the white clover plot. The results of the determination of nitrogen as nitric acid in the various samples are tabulated below, the figures being pounds per acre:—

Depths.	Unmanured Wheat and Fallow Land	Mineral (non-nitrogenous) Manure.		
		Trifolium repens, Plot 4.	*Vicia sativa.* Plot 4.	*Vicia sativa.* Plot 6.
Inches. 1—9	19·85	30·90	12·16	10·22
10—18	8·05	27·73	4·11	2·72
19—27	2·47	8·44	1·37	1·08
28—36	2·70	7·61	1·67	1·52
37—45	1·62	9·07	4·58	2·54
46—54	3·57	8·77	6·37	1·42
55—63	3·84	7·92	7·16	4·52
64—72	2·28	8·34	5·95	4·92
73—81	1·48	8·27	4·54	1·84
82—90	1·76!	9·95	5·32	5·14
91—99	2·94	9·16	5·66	6·10
100—108	1·84	9·51	5·32	6·46
1—108	52·40	145·70	64·24	51·72

Comparing the wheat-land fallow plot with the *trifolium repens* plot, which was practically fallow, there is a remarkable difference in the amounts of nitrogen as nitric acid. Looking to the previous history, the one had grown wheat alternately with fallow for more than thirty years, and the other, during the same period, had grown six gramineous crops, been frequently fallow, but had been sown twelve times with red clover, and during the immediately preceding six years four times with white clover. Thus, irrespective of the, for the present purpose, unimportant dressing with mineral manure in the one case and not in the other, the whole difference had been the introduction of leguminous crops on the one, and not on the other, with the result that there is nearly three times as much nitrogen

as nitric acid found in that soil, to the depth of 108 inches, as in the other to a corresponding depth. It is hence inferred that nitrification is more active under the influence of leguminous than of gramineous growth and crop residue. Sub-soils have been found to contain no nitrifying organisms (Warington, *J. Chem. Soc.* (Trans.), 1884, 637); but from other experiments the authors have shown that the nitrogen of sub-soil, when subjected to suitable conditions, is capable of nitrification. The beneficial influence of leguminous growth is shown at a great depth, with strong, deep-rooted *melilotus leucantha*, for the channels made by its roots and by worms, would allow the nitrifying organism to pass down along with other substances, whilst owing to the large quantity of water drawn up (see above), air, water, etc., must necessarily pass down. Therefore, upon this supposition the greater the root development the greater would be the amount of nitric acid formed, and of nitrogen rendered available in this form to the plant from the sub-soil. If established this would go far to explain the large amounts of nitrogen yielded by these deep-rooted leguminous crops over a given area; and would, moreover, account for the fact that where a crop of a certain root-range has failed, having exhausted its store of suitable nitrogenous matter, a plant of another root-range thrives. Thus *melilotus leucantha*, *vicia sativa*, and *medicago sativa* succeeded where red clover failed, and clover throve where beans had failed. Hence, in explanation, it is suggested, supposing a healthy leguminous plant is established, whether its growth, excretions, and residue do not exert a favourable influence on the development of the nitrifying organism, at first in the rich upper, subsequently in the poorer lower layers of the soil, and thus gradually render the organic nitrogen of the soil and sub-soil available for the requirements of growth; consequently there is a large crop, and a large crop residue, which enriches the surface soil. But this explanation requires proof. With regard to the assimilation of nitrogen in organic combination from the soil, by green-leaved plants, it is pointed out that there is no direct evidence in favour of such a view, whilst there are physiological considerations which seem to be against it. On the other hand the assimilation of nitric acid is evident from the above table, when the quantities of nitrogen as nitric acid found in the *trifolium repens* plot, where there was no plant to take it up, is compared with the nitrogen as nitric acid in the *vicia* plots, where there was plenty of growth to utilise the nitric acid formed; so great is the difference that the nitrogen deficit in the *vicia* plots is sufficient to account for a large proportion of the nitrogen contained in the *vetch* crop. Other experiments are described, which likewise bear indirectly on this point, and are accordant, but which more directly illustrate the loss of nitrogen, which may result from leaving land fallow during a wet season; it is hence deemed advisable to keep land covered with a crop to take up the nitrate as it is produced. In concluding this part of the paper the authors regard as established that a considerable quantity of the nitrogen of plants is derived from the stores in the soil, and that much, and in some cases the whole, of this nitrogen is taken up as nitrate.

From the above suggestions it would seem that a soil containing sufficient available mineral constituents, and a large proportion of nitrogen, which is readily nitrified, may be regarded as fertile; and, therefore, virgin prairie soils should fulfil these conditions. To test this point the following investigations were made with Manitoba prairie soils, which are not deficient in mineral matter. Surface soils, from Portage la Prairie, which had been under cultivation several years, from the Saskatchewan district also under cultivation some time, and from Fort Ellice, virgin soil, contained respectively 0·2471, 0·3027, 0·2500 per cent. of nitrogen, and are twice as rich in nitrogen as the average arable soil in Great Britain, and perhaps about as rich as the average of the surface soils of permanent pasture land. Four other Manitoba soils were more thoroughly examined, and experiments were conducted to ascertain the susceptibility to nitrification of the nitrogen in them. The soils were (1) from Niverville, about 44 miles west of Winnipeg; had been broken from the prairie five or six years, and had grown five crops of cereals. (2) From Brandon, about 132 miles west of Winnipeg; had been broken up in 1882, back set in 1883, and grew 25 bushels of wheat per acre that year. (3) From Selkirk, which had never been broken up. (4) From Winnipeg; broken up about five years; had been thoroughly cultivated, and manured, and had grown good crops of potatoes. There were four samples of each of these soils investigated, representing the first, second, third and fourth 12 inches from the surface. For the nitrification experiments the samples were extracted with water on a vacuum pump, the nitrogen as nitric acid estimated in the extract, and the extracted soils were broken up, exposed to the air in shallow vessels in a moist condition, and at a suitable temperature, being covered loosely with glass plates to protect them from dust; at the end of periods of about twenty-eight days or more the samples were again extracted, the nitrogen as nitric acid determined in the extract, and the extracted masses exposed as before. After the fourth extraction, potassium phosphate, magnesium sulphate and calcium carbonate were added to the samples to replace the mineral matter removed by the repeated extractions, as it might be that the reduction of nitrification noticed at that period was due to the want of mineral matters necessary for the development of the nitrifying organism; whilst after the seventh period some of the less active samples were seeded with 0·1grm. of rich garden mould. The results are given in table on p. 606. The first column of results shows the total quantity of nitrogen, whilst the following columns indicate the condition of the nitrogen, or its nitrifiability and usefulness to plant life. When it is remembered that the percentage of nitrogen in the dry arable soils at Rothamsted, in the first 9 inches, seldom exceeds 0·14 or 0·15, and is sometimes as low as 0·10; in the second 9 inches it ranges from 0·07 to slightly more than 0·08; in third 9 inches from below 0·06 to about 0·07, whilst in the lower depths it is still less, it will appear that these Manitoba soils are undoubtedly very fertile, and may be compared to the surface soil of old pasture land at Rothamsted, which contains from 0·25 to 0·30 per cent. of nitrogen. The second column of results relates to the amount of nitrogen as nitric acid found in the samples, at the commencement of the experiments, and are naturally irregular, owing to the different conditions of the samples, as to moisture, etc. The third and subsequent columns of results show the progress of nitrification. It will be seen that in each set of soils the nitrification is greater in the richer surface soils than it is in the poorer sub-soils, and generally, but not uniformly, greater in the second than in the third, and in the third than in the fourth depth of 12 inches. When the activity began to diminish at the fourth period, the mineral matter was added to all the samples, but without improving matters, owing at first to the quantity added being too great; but even in a subsequent extraction (7th period) the production of nitric nitrogen was still very small, and therefore the garden soil was added as already stated, with the result indicated in the last column, where the amount of nitrogen nitrified shows a considerable increase over that of the seventh period. The percentage of the original nitrogen nitrified throughout the experiment up to the end of the eighth period, was, in each case, as follows:—

	Niverville.	Brandon.	Selkirk.	Winnipeg.
1st depth	3·21*	4·78	3·77	5·42
2nd „	1·26	1·64*	4·48	3·55
3rd „	0·51	2·07	1·00	4·85
4th „	1·00	1·22	0·77	2·78

It is remarked that the conditions of these experiments cannot be compared with those of the soils in their actual conditions of aeration, moisture and temperature; nevertheless, the results are very important, showing, if the sub-soils are really pure, that the nitrogenous matter of sub-soils is liable to nitrification when the conditions are suitable for such a change to take place. This susceptibility of the nitrogen to oxidation may be a source of loss, if there is no crop to take up the nitrates

* Too low.

when formed. In spite of the great richness of these soils, they do not produce as much wheat per acre per annum as is obtained in Great Britain; this is owing, in part, to unfavourable climatic influences, and short seasons of growth, but more largely to scarcity of labour, and consequently bad cultivation. A table is given comparing the percentage of nitrogen and carbon in various soils of known history—Rothamsted arable and grass soils, arable soils in Great Britain, United States (Illinois) and Canadian prairie soils, and rich Russian soils, from which it seems that the rich virgin soils, or permanent pasture surface soils, contain a high percentage of nitrogen and of carbon, and a high relation of carbon to nitrogen. An arable soil which has long been under cultivation, is much poorer in these respects; whilst an agriculturally-exhausted arable soil shows very low percentages of nitrogen and carbon, and a very low relation of carbon to nitrogen. A fertile soil may then be defined in the words of the authors, as one "which has accumulated within it the residue of ages of previous vegetation, and that it becomes unfertile as this residue is exhausted." The paper terminates with a copious summary and the conclusions of the authors.—D. A. L.

Depths.	Per cent. Nitrogen in Dry Soil.	Nitrogen as Nitric Acid per Million Dry Soil.										
		Original.	Periods of Exposure.									
			1st.: 28 days.	2nd.: 28 days.	3rd.		4th.		5th. & 6th: 79 days.	7th.: 28 days.	8th.	
					No. of days.		No. of days.				No. of days.	
					Soil from Niverville.							
1st.	0·261	2·70	11·33	9·11	87	45·75	35	lost.	0·11	4·65	49	9·32
2nd.	0·169	0·18	3·13	3·23	85	1·89	38	1·11	3·11	0·57	28	(6·66)
3rd.	0·069	0·62	0·38†	0·35	82	0·34	38	0·11	0·78	0·21	28	(1·28)
4th.	0·038	0·74	0·41	0·59	71	0·51	38	0·29	1·10	0·18	28	(0·63)
					Soil from Brandon.							
1st.	0·187	0·23	9·13	8·82	87	33·55	35	12·51	10·15	6·94	49	8·34
2nd.	0·109	1·50	1·43*	1·05	85	3·27	35	5·70	1·03	2·37	49	lost.
3rd.	0·072	0·75	1·56†	3·81	82	1·05	38	1·71	0·79	0·24	28	(2·75)
4th.	0·019	1·40	0·52*	0·28	74	0·18	38	0·09	0·44	0·16	28	(0·67)
					Soil from Selkirk.							
1st.	0·618	3·94	18·13	31·77	87	58·83	35	21·90	28·23	21·73	49	17·39
2nd.	0·261	3·08	13·67*	22·71	77	26·61	35	11·30	14·98	13·61	49	15·06
3rd.	0·076	0·52	0·99	1·86	71	1·08	35	0·45	0·78	0·27	28	(2·10)
4th.	0·012	0·31	0·19	0·22	62	0·77	38	0·35	0·83	0·23	28	(0·69)
					Soil from Winnipeg.							
1st.	0·428	132·37	38·09	28·85	88	57·75	35	35·03	22·95	21·23	49	28·26
2nd.	0·327	83·19	5·95*	21·75	85	24·27	38	17·97	21·79	3·95	49	17·74
3rd.	0·158	36·02	12·40	17·64	77	7·91	40	12·02	10·88	2·11	28	(13·63)
4th.	0·107	11·52	5·70	8·16	57	0·72	45	4·03	0·25	0·55	28	(10·11)

Results marked thus * are too low. Those marked thus † are after 26 days, and those in brackets ( ) are 28 days after adding the garden soil.

On the Influence of "Nitrate of Soda" and ordinary Saltpetre on Potatoes. P. Dehérain. Bied. Centr. **13**, 424.

According to experiments made by Elder, at Gingenött, a better yield of potatoes is obtained when potassium nitrate is used than when sodium nitrate is employed. The author, having repeated these experiments has not remarked this difference, and has arrived at the conclusion that nitrate of sodium in the soil is changed into potassium nitrate, and that only the latter is assimilated by the plants. A difference between the action of the two salts is only observed in those soils in which there is a deficiency of potassium, and in which, therefore, conversion of the sodium salt into the potassium salt cannot take place. An instance of this conversion is furnished by the author, who states that although the ash of some beans, which, before incineration, had been immersed in solutions of common salt contained 11·2 per cent. of chlorine, no sodium, but on the contrary, abundance of potassium was found.
—E. G. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

Microbes in the Filters of Sugar Refineries. T. Mendes. Ztschr. d. Ver. f. Rüben. Zuckerind. **22**, 396—406.

The sugar-water from the refinery filter occasionally becomes turbid and of a pale yellow-white colour. A sample of this water had a smell of sour milk, became acid, and gave a precipitate with ammonia of calcium phosphate and carbonate, and eventually turned black. From a microscopic examination of the weak syrup and sugar-water from several sugar factories at

different periods the author finds that in all cases the turbidity is due to the same microbe, which is recognised by its bacillus-like form. The germs of this bacillus do not lose their vitality even at the temperature of boiling water. The original paper is accompanied with figures. —S. R.

On Some Reactions of Saccharin. P. Herrmann and B. Tollens. Ber. **18**, 1333.

IT has been shown by Tollens and others that true carbohydrates when boiled with dilute mineral acids yield levulinic or β-acetopropionic acid, while other substances of similar composition, such as methylenitone and inosite, do not yield this acid, and Kent and Tollens have suggested that the production of levulinic acid from a vegetable matter is a proof that it is a carbohydrate.

Saccharin, which has the same composition as starch, but a different constitution, was boiled with hydrochloric acid for twenty hours, but the greater part of the saccharine remained unaltered, and the presence of levulinic acid could not be recognised. The substance is therefore not a true carbohydrate.

It has been suggested by Kiliani and by Liebermann and Scheibler that saccharin is the lactone of saccharic acid, the latter being a substitution product of lactic acid.

A concentrated solution of saccharin when treated with potassium iodide solution and sodium hydrate yielded considerable quantities of iodoform, hence it is almost certain that the substance contains a methyl group.

Lactic acid was also prepared from saccharin by heating the substance with an aqueous solution of potassium hydrate, and allowing the temperature to rise gradually to 220°. (At a higher temperature lactic acid is decomposed with formation of oxalic acid.) The authors conclude that saccharin is an intermediate product between dextrose and lactic acid, and that it is the lactone of a lactic acid in which hydrogen is replaced by the group $-CH.OH-CH.OH-CH_2.OH$.—S. Y.

On the Waste Waters from Sugar Factories. W. Demel. Bied. Centr. **13**, 361.

THE author has analysed the waste waters from various sugar works. One series of results obtained by him is embodied in the following table:—

No.		Parts in 1000,000. Loss on Ignition.	Non-volatile residue.	Total solid matter.	Ammonia.	Value of Permanganate required for Oxidation of Organic substances.	Reaction.
1	Suspended	34·52	504·01	538·53	—	—	—
	Dissolved	16·01	12·02	28·06	2·13	20·01	Neutral.
	Total	50·56	516·03	566·59	—	—	—
2	Dissolved	380·09	2736·00	3116·09	1·82	196·62	Acid.
3	Dissolved	1130·07	427·50	1557·57	0·41	3706·15	Basic.
4	Suspended	8·62	58·22	66·84	—	—	—
	Dissolved	20·91	16·32	37·23	1·50	24·57	Neutral.
	Total	29·53	74·54	104·07	—	—	—

No. 1 is beet wash-water from the washing machine. Yellowish-brown, when examined in a layer two centimetres thick; opaque; contained earthy matter, fibres, etc. *No. 2* is boneblack wash-water. Turbid, yellowish-grey, with numerous suspended particles. *No. 3* is osmose-water. Clear yellow, with smell of syrup. *No. 4* is the entire waste-water as it leaves the works, after passing two large settling-tanks. Turbid, with a very thick sediment and offensive odour. The author concludes by pointing out the great objections attaching to the pollution of river-water with such obnoxious fluids as these.—E. G. C.

On the Separation of Raffinose from the Molasses of the Sugar-beet. C. Scheibler. Ber. **18**, 1409.

FIFTEEN years ago the author noticed the occasional occurrence of sugars the complete analysis of which yielded numbers greater than 100. Such sugars, therefore, appear to contain no non-saccharine organic substances. The author suspected the presence of a body of high rotary power and of dextrin.

It is only, however, of late years since the introduction of the method of obtaining sugar from molasses by means of strontium hydrate that the question has received much attention, and that the observation of analyses of sugar solutions giving numbers greater than 100 has become common, that from such solutions the sugar has been observed to crystallise in peculiar elongated prismatic forms, which are, however, in reality only distorted forms of ordinary sugar crystals.

In 1882 Reichardt and Bittmann again concluded that a body of high rotary power must be present, and quite recently Tollens (*Ber.* **18**, 26) suggested that this body was the raffinose discovered by Loiseau, probably identical with gossypose prepared from cotton-seed cake. Raffinose was evidently obtained accidentally by Loiseau, and no direct method of preparation has yet been described. The author now shows how it may be prepared in quantity. The materials employed were the elongated crystals, the after product and the syrup obtained by Steffan's method from beet-root molasses. The crystalline products were dissolved in hot water, and to one molecule of sugar (calculated by rotary power) one molecule of strontium oxide was added. After cooling, a little monostrontium saccharate was added to induce crystallisation, and after some hours the crystallised product was separated by filtration with the pump. The mother-liquor, which contained seventy-five per cent. less sugar than the original solution, was treated with excess of strontium oxide, whereby the remaining sugar and the raffinose were both precipitated. After filtering and washing with ten per cent. boiling strontium solution, the strontium was removed with carbon dioxide. The sugar thus obtained, calculated from its rotary power, gave an apparent value of 103·3 per cent.

This double precipitation was twice repeated, the numbers rising to 108·4 and 109·2. Complete separation was now effected by fractional precipitation with alcohol. To the syrup, now rich in raffinose, absolute alcohol was added until a permanent turbidity was observed in the hot solution. After twelve hours a

syrupy layer very rich in raffinose had separated. This was treated twice in the same way. Lastly alcohol was added in the cold until the turbidity just disappeared on shaking, the flask was then closed and the solution allowed to stand. After some days the raffinose separated in tufts of needles, which were completely purified by recrystallisation from alcohol. A description of the sugar will be given in a future paper.—S. Y.

New Sweet Compound and Process of Manufacturing the same. J. Y. Johnson, Middlesex. From Constantin Fahlberg, New York, U.S.A.; and Adolph List, Leipsic. Eng. Pat. 6626, June 1, 1885.

By means of this invention a new sweet compound may be prepared from coal-tar or analogous substances, containing a considerable proportion of benzene, toluene, etc. The inventors name the new substance "Saccharine," although it is not related to the class of sugars, but is a derivative of benzoic acid. The scientific name of the substance is benzoylsulphimide, and it has its composition represented by the formula—$C_6H_4.CO.NH.SO_2$. It possesses a taste similar to saccharose, but far sweeter, so that it may be employed as an advantageous substitute for sugar in all cases where the latter would be too expensive; for instance, in sweetening glucose, grape or starch sugar, and in other cases where cane-sugar is used for sweetening and preserving. A very diluted solution thereof tastes like a saturated solution of cane-sugar, and it has high antiseptic properties, which will further recommend it for many purposes in the arts and medicine. Owing to the fact that "saccharine" cannot be classed under the heading of nourishments, like sugar and similar carbohydrates, it may be used for many medical purposes where cane-sugar is excluded from the diet of certain patients, as in cases of "diabetes mellitus," and other diseases. Saccharine is difficultly-soluble in cold water; it is more soluble in warm or hot water, and can easily be obtained from such solutions in crystalline form. Alcohol and ether dissolve it readily. It crystallises in thick short prisms, in all probability belonging to the monoclinic system; they are, however, small, and imperfectly formed. It fuses about 200° C., under partial decomposition. It forms salts with the alkalis and alkaline earths, etc., similar to those formed by cane-sugar, these salts having the same pleasant and sweet taste as pure saccharine. Two very complex methods of preparation are given, the nature of which may be indicated as follows:—Toluene is heated with sulphuric acid to form sulpho-acids, which are first converted into lime-salts, then into soda-salts, the latter being treated, after drying, with phosphorous pentachloride to form sulpho-chlorides, one of which is then treated with dry ammonia gas to form an amide, which after oxidation by means of potassium permanganate yields the potash salt of "saccharine," from which by precipitation with a dilute mineral acid the pure "saccharine" is obtained.—A. W.

XVII.—(*A*) CHEMISTRY OF FOOD. (*B*) SANITARY CHEMISTRY. (*C*) DISINFECTANTS, Etc.

(*B*) SANITARY CHEMISTRY.

Notes on Leaden Service-tubes for Water-supply. S. Steiner. Chem. Centr. **16**, 524.

The water-supply of Budapest is carried into the houses in leaden pipes. The pipe for the water of the Hygiene Institute, which served for these experiments, was 39m. long, and had been laid for ten years. A sample of water taken, after a quick stream had been allowed to flow through the pipe, contained 0·085mllgrm. lead per litre; after a slow stream, 1·04mllgrm.; the water in the pipe after standing for twenty-four hours contained 1·224mllgrm.; after forty-eight hours, 1·7mllgrm.; after seven days, 3·25mllgrm.; and after a month, 4·7mllgrm. The water taken from the street-hydrant contained no lead. The amount of lead present was determined by evaporating the water with nitric acid, then treating with hot hydrochloric acid, and precipitating with sulphuretted hydrogen; finally weighing as lead sulphate. —S. R.

Clarification of Waste Waters from Dyeworks. E. Hankel. Mittheilungen des Gewerbe-Museums in Wien, May, 1885.

To effectually clarify the waste-water from dyeworks it is recommended to treat the water with lime, allow the mixture to settle, draw off the supernatant solution, and pass the sludge through filter-presses.—D. B.

Purification of Water according to the Gaillet and Huet System. Mittheilungen des Techn. Gewerbe-Museums in Wien, May, 1885.

This process involves the use of caustic lime and caustic soda. The purified water contains sodium sulphate and sodium chloride—*i.e.*, salts which are perfectly harmless. The practical results achieved are very satisfactory, as will be seen from the following figures showing the hardness of the water before and after purification:—

	Hardness before purification.	Hardness after purification.
1.	23—27°	2—4°
2.	29	2—5
3.	39—42	3—5
4.	42	4—6
5.	26	4—5
6.	38—40	3—5

—D. B.

Poisoning by Coal-Gas and Charcoal Fumes. J. Poleck. Rep. Anal. Chem. **5**, 225.

The author published together with Biefel, in the *Zeit. Biol. Chem.* 1880, an investigation of this subject, which has been subjected to a lively criticism by A. Wagner (*Rep.* Nov. 1884). Against the strictures of the latter the author enters a strong protest, especially vindicating the methods adopted for collecting the gases, and the results of their analysis.—C. F. C.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in the Manufacture of Phosphates. Ph. M. Justice, London. From Sidney Gilchrist Thomas, Paris. Eng. Pat. 11,805, August 30, 1884.

This invention relates to the manufacture of phosphates free from iron, from phosphoric slags and minerals containing iron. The material is dissolved in acid, and the current from a dynamo-electric machine passed into the nearly neutral solution until the whole of the iron is deposited. The free phosphoric acid may be used for preparing high-class phosphates.—S. Y.

Improvements in Secondary Batteries. Ernest George Dornbusch, London. Eng. Pat. 11,853, Sept. 1, 1884.

In Faure's and other secondary batteries in which the electrodes are enclosed in, or separated by means of felt, flannel, or other suitable absorbent material, the salt of lead is liable to penetrate through the material and establish short circuits between the two electrodes forming the secondary couple. The inventor taking account of this penetration of the lead salt through the absorbent material, makes the latter a carrier or support for the active substances. The lead plates are slit into strips from a short distance from one edge right down to the opposite edge, and the felt or other material is folded backwards and forwards so as to completely cover the plates. The prepared plates are then impregnated with the lead compound, and finally dipped into a paste of red lead and water. They are then placed in bags of felt or flannel, and reduced or peroxidised to form the elements of the secondary battery.—S. Y.

Carbon Fabrics or Materials, their Manufacture and Application. Joseph Stokes Williams. Eng. Pat. 12,065, September 5, 1884.

This method of manufacturing carbon sheets, ribbons, fabrics, plates, or rods for use in electrical work consists

in impregnating vegetable matter, moulded or woven into the desired shape, with starch, dextrin, or finely-divided wood pulp or paper, and subsequently carbonising in a chamber charged with hydrocarbon vapour. The material may also be impregnated with finely-divided carbon, and the subsequent carbonising be performed by passing a strong current of electricity through it.—E. J. B.

Improvements in Apparatus for Lighting Gas and other Inflammable Substances. James Grieve Lorrain, London. Eng. Pat. 12,139, September 8, 1884.

THE apparatus is a form of continuous electrophorus or convection induction machine, by means of which sparks are made to pass between two outer points. Various devices for causing rotation are described, and methods are adopted for regulating the distance between the points, and for securing perfect insulation and dryness. —S. Y.

Improvements in Secondary Batteries or Accumulators. Desmond Gerald Fitz-Gerald, Brixton. Eng. Pat. 12,350, September 12, 1884.

THE object of this invention is to diminish the time required to "form" the plates in the secondary battery of the Planté type, and to allow of the substitution in other forms of accumulator of a simple plate of lead in place of anodes of more complicated structure. The invention consists in employing a solution of magnesium sulphate as the electrolyte in charging the secondary battery. As the solution becomes acid magnesia or magnesium carbonate is added. When the battery is discharged the magnesium sulphate may be replaced by dilute sulphuric acid. The process of "forming" can thus be effected by one reversal of the current, that is, by two operations of charging in opposed directions. The solution of magnesium sulphate is also applied to those batteries in which the lead plates are roughened, corrugated, or perforated, in which case only one operation of charging is required.—S. Y.

Improvements in Voltaic Batteries. Desmond Gerald Fitz-Gerald and T. J. Jones, London. Eng. Pat. 12,802, September 25, 1884.

THE inventors point out that zinc is unsuitable for the positive element of a primary battery, because it is impossible economically to recover the zinc in the metallic state from the sulphate. They propose to employ spongy lead as positive elements, and lead peroxide as negative elements, and the essential feature of the invention consists in the conversion of sulphate of lead into spongy lead to form the positive elements, and of spongy lead prepared in this or other ways into lead peroxide for the production of negative elements, both operations being performed by means of electrolysis. In the first operation a pasty mass of sulphate of lead and magnesia or an alkali, is spread on lead plates, and after hardening the sulphate is reduced in tanks in which the electrolyte is magnesium sulphate. In preparing the negative element the spongy lead is allowed to oxidise partially in the air, and is peroxidised by means of electrolysis. —S. Y.

Improvements in Primary or Galvanic Electric Batteries and in their Construction. Blanche A. Rowan, Southsea. Eng. Pat. 13,744, October 17, 1884.

BY using broken carbon, moistened with a solution of any metallic nitrate, such as the nitrate of mercury, silver, aluminium, chromium, lead, copper, or iron, enclosed in an envelope or hollow cell of carbon to form a negative electrode, and as a positive electrode zinc immersed in a solution of any suitable chloride, such as sal-ammoniac, a battery is formed having a constant current and a high electromotive force.—T.

A Compound Galvanic Battery. S. H. Emmens, London. Eng. Pat. 13,759, October 17, 1884.

THE compound battery referred to, consists of a primary charging a secondary battery, the cells of each class being of any known construction. This combination reduces the labour of charging and discharging, the electromotive force of the primary battery being easily brought to any required degree of tension. Constant action of the secondary battery is maintained by replenishing the primary battery while at work.—T.

Improvements in the Preparation or Manufacture of Elements for Primary Electric Batteries. C. P. Elieson, Essex. Eng. Pat. 14,197, October 27, 1884.

PLATES or other pieces of carbon are placed in water or other solution capable of giving off oxygen, a current of electricity is then passed through the carbon in order to charge it with oxygen. After having been charged to the desired extent, the plates or pieces are removed from the liquid and exposed to the air, in order that they may become thoroughly oxidised. By using carbon prepared in this manner, the efficiency of a battery is greatly increased on account of no rapid polarisation taking place.—T.

Improvements in Galvanic Batteries. Gustavus Baron de Overbeck, London. Eng. Pat. 14,485, November 1, 1884.

IN order to prevent the polarisation produced in batteries by the formation of bubbles of hydrogen on a carbon or other insoluble electrode, the author proposes to use an aqueous solution of a hypochlorite salt, or free chloric acid, or free perchloric acid, adding as may be suitable sodium or potassium chloride.—T.

Improvements in and connected with Electric Batteries or Elements. P. M. Justice, London. Eng. Pat. 14,548, November 4, 1884.

THIS invention has for its object the more complete separation of the liquids in hydro-electric elements or batteries of two liquids by means of a porous membrane of gold-beaters' skin, amianthus or ordinary paper, or by a porous ring or disc of terra-cotta, or the like placed in a slanting position between the heavy and lighter liquid, and having a tube inserted into it in such a way that the gases formed can escape through the tube without disturbing the liquid above.—T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in Treatment of Xylonite, etc. A. J. Boult, London. From W. C. Zeidler, Toronto. Eng. Pat. 8012, July 1, 1885.

THE object of this invention is to provide a simple, quick, and effective process for polishing the surface of celluloid, xylonite, zylonite, chrolithion, pyroxyline, and similar substances, and at the same time to secure the said material when made in any shape to wood or other material. It consists essentially in submitting the celluloid or like material to pressure while treated, and preferably cooling the same off. Only a few minutes are occupied in pressing, heating, and cooling. "By the adoption of this process it only occupies about five minutes from the time that the celluloid is first glued on to the board until it is polished and finished ready to be cut into keys, etc."—H. A. R.

Improvements in the Manufacture of Vegetable or Paper Parchment. T. R. Shilito, London. From C. Arnold, Germany. Eng. Pat. 8130, July 4, 1885.

THE main points of interest in this invention are the following :—1. In the manufacture of the parchment the method of washing out the acid from the material under treatment by the repeated use of the same acidulated

water until its degree of concentration has reached a certain point, for the purpose of the more advantageous recovery of the acid substantially as described and illustrated. 2. A chest, which is cooled by fresh water, and from which the acidulated water is continuously removed where it is least saturated with acid, and is conducted to the jet-pipes for this purpose, as described in the specification. The drawing should be consulted.
—H. A. R.

Improved Process of Preparing Sulphate of Lime for Paper-making, etc. C. W. Knowles, Nova Scotia. Eng. Pat. 12,193, September 9, 1885.

INVENTOR prepares a thick or semi-solid pulp of the sulphate with water, in a convenient form for immediate use, or for transit, packing, etc.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Liquid Carbonic Acid. H. Herberts. Chem. Centr. **16**, 558, 560, 572.

LIQUID carbonic acid can now be bought in iron or steel bottles containing 8kilos. of the liquid, which corresponds to about 4000 litres of the gas at ordinary temperature and pressure, and costs about 1 mark per kilo. At this price it furnishes the cheapest means for aerating beer and mineral waters, and is also extensively used for raising sunken ships, for driving torpedoes, for extinguishing fires, for cooling purposes, and by the firm of Fr. Krupp in Essen for the condensation of steel and other metals, and is further suggested as a motive power for tramcars and air balloons. In the German patent No. 28,769, a method for the preparation of carbonic acid and Glauber's salts from acid sulphates (bisulphates) is described. A bisulphate containing 70 per cent. of sodium sulphate, and 25 to 30 per cent. of free sulphuric acid can be used with advantage. The apparatus employed is described in detail in the specification, and consists essentially of a leaden vessel containing a solution of the bisulphate, and having a stirring apparatus and gear fixed airtight to it. By means of a tube and pump an equivalent quantity of chalk or other carbonate suspended in water in a second vessel can be forced into the first, and the stirrer is then set in motion. The liberated carbonic acid passes through a suitable drying apparatus to a gasometer, from which it is afterwards condensed. The residue consisting of calcium and sodium sulphates is removed to a filter press, and the sodium sulphate crystallised or calcined from the filtrate. The calcium carbonate employed is that obtained as a waste product in the manufacture of caustic. It is suggested that magnesium carbonate should be substituted for chalk, thereby getting no precipitate but a double sulphate of magnesium and sodium which could be used for the preparation of sulphuric anhydride. By the evaporation and expansion of the liquid carbonic acid, a large quantity of heat is absorbed. An apparatus is described for allowing this to take place round a tube containing a solution of calcium chloride; the latter is so cooled that it can be used for freezing water and the manufacture of ice. The carbonic acid, which is thus used, passes over sodium carbonate, which is thereby converted into bicarbonate if care be taken that the necessary amount of moisture is present. The bicarbonate formed in this way is used over again in the carbonic acid manufactory.—S. R.

On Artemisia Gallica, Wild., as a Source of Santonin, and on its Chemical Composition. Ed. Heckel and Fr. Schlagdenhauffen. Compt. Rend. **100**, 804—806.

THIS plant, which is widely distributed in France, contains 1 per cent. of ethereal oil, and a crystalline body (camphor?) volatile with steam. The flowers give 3 per cent. of extract with petroleum, consisting chiefly of wax, a yellow colouring matter and some chlorophyll. The chloroform extract contains considerable quantities of santonin, and a resinous body apparently isomeric with santonin. The alcoholic extract from the whole plant contains glucose, tannin, colouring matter, and an alkaloid.—S. Y.

Paraldehyde as a Remedy against the Poisonous Action of Strychnia. Arpád Bókai. Chem. Zeit. **9**, 960.

THE author has found in paraldehyde a powerful antidote against poisoning by strychnia. Hitherto chloral-hydrate has been used, but owing to its powerful action on the heart, paraldehyde is recommended. It is said to act as counter poison to brucine, thebaïne and picrotoxine.
—D. B.

The Estimation of Glycerol in Aqueous Solution and in Fats. R. Benedikt and R. Zsigmondy. Chem. Zeit. **9**, 975.

THE authors find that the method adopted by Fox for the detection of glycerol in linseed-oil varnish is, if conducted with certain precautions, capable of giving accurate quantitative results when applied either to the estimation of glycerol in aqueous solutions or to the examination of fats. The method depends upon the oxidation of glycerol, by permanganate in alkaline solution, to oxalic acid, carbon dioxide, and water, in accordance with the equation—

$$C_3H_8O_3 + {}_3O = C_2H_2O_4 + CO_2 + 3H_2O.$$

The following are the details to be observed in the estimation of glycerol in aqueous solutions: An amount of solution which shall contain about 0·2—0·5grm. of glycerol, is rendered alkaline by the addition of 10grm. of pure potassium hydrate, and then potassium permanganate, either as a five per cent. solution, which is best, or in the solid form, added until the liquid appears almost black. The mixture is heated to boiling, whereby a separation of manganese dioxide takes place, decolourised by means of sulphurous acid, passed through a filter of sufficient size to hold at least one-half of the liquid at once, and the residue well washed with boiling water. The filtrate is acidified with acetic acid, which, by setting free sulphurous acid, causes the removal of any turbidity due to manganese peroxide. The filtrate is then precipitated with acetate of lime. The precipitate contains sulphate of lime and silicic acid in addition to calcium oxalate, hence the amount of oxalic acid cannot be inferred from the weight of the residue after ignition, but is to be arrived at either by titration of the precipitate with permanganate in acid solution or by determining the alkalinity of the ignited precipitate. Test analyses gave 90·3, 91·4, 92·3, and 92·7 per cent. of glycerol instead of 91·0 per cent., and in a dilute aqueous solution containing 0·05 per cent., this method gave 0·0507 per cent., 600grm. being taken for the analysis. For the determination of glycerol in fats, from two to three grammes of ordinary fats, and from ten to twenty grammes when the proportion of glycerol is small, will be found sufficient. The fat is saponified with potassium hydrate and *pure* methylic alcohol, the alcohol evaporated off, and the soap dissolved in hot water, and decomposed by dilute hydrochloric acid in excess. Heat is now applied to effect the complete separation of the fatty acids, and, in the case of liquid fats, some hard paraffin is added to assist the solidification of the fatty acids, the dish being set in cold water. The acid liquid is filtered into a capacious flask, the fatty acids being well washed with water; the filtrate is neutralised with potash, and, after a further addition of 10grm. of potassium hydrate, the glycerol estimation proceeded with, as described above. The authors employ methylic and not ethylic alcohol in the saponification, since the latter is completely expelled from the soap with difficulty, and under certain conditions of alkalinity and concentration of the solution, is oxidised by permanganate to oxalic acid. It has been found by experiment that the soluble fatty acids—viz., acetic, butyric, and caproic—do not, when subjected to the oxidation process above described, yield any acids precipitated by lime in acetic acid solution. The authors have obtained the following results with various fats:—Olive-oil, 10·15—10·38 per cent. of glycerol; linseed-oil,

9·45—9·97; cocoa-nut oil, 13·3—14·5; tallow, 9·94—9·98; butter, 10·21—11·59; Japan-wax, 10·3—11·2; beeswax, 0·00. Since the fats contain, upon an average, 10 per cent. of glycerol, which is not found at all in beeswax, the percentage of fat in a sophisticated beeswax may be calculated with sufficient accuracy for technical purposes, by multiplying the percentage of glycerol found by ten.—W. D. B.

Examination of Essential Oils. H. Hager. Pharm. Centr. 1885, 316.

For the examination of certain essential oils, chiefly with the view to distinguish the "natural" products from artificial imitations, the author employs an aqueous solution of mercuric nitrate (10 per cent.). Four drops of the essential oil are dissolved in 2cc. of alcohol, and 2 to 3 drops of the nitrate solution added. No reduction occurs with the essential oils of laurel (ol. lauro cerasi) and bitter almonds. The greater number of oils, however, have a reducing action on the nitrate, and their presence in admixture with the above is indicated by the formation of a grey precipitate of metallic mercury. The artificial bitter almond water also precipitates the solution, and is thus distinguished from the natural. The following oils—viz., ol. cassiæ cinn., succini, petræ, linanthracis, vinceæ, vitis viniferæ—do not readily reduce the nitrate, but their presence in bitter almond oil is indicated by the opalescence occassioned by diluting with alcohol (6 parts of sp. gr. 0·895). Mustard oil treated under the above conditions gives a slight reduction; the artificial products sold under this name were found, on the other hand, to reduce rapidly, giving a dark-grey precipitate.—C. F. C.

Papaverin. G. Goldschmiedt. Monatsh. Chem. **6**, 372.

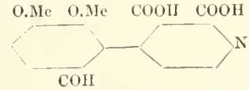
In continuation of a previous communication (*Ibid.* 4, 704) the author gives the results of a further investigation of the oxidation of papaverin by potassium permanganate in dilute aqueous solution at the boiling temperature. In addition to carbonic and oxalic acids and ammonia, the following products of the reaction were isolated:—(*a*) Dimethylprotocatechuic acid (melting point 180°); (*b*) an acid body which, from its composition, $C_{10}H_{10}O_6$, melting point 180°, and reactions, appeared to be hemipic acid (*Ibid.* 3, 351); (*c*) the main product, which is an acid, having the composition $C_{16}H_{13}NO_7$, melting at 233°, and termed by the author papaveric acid. It is a dibasic acid, giving both acid and basic salts with the alkali metals. The following salts are described:—

$C_{16}H_{11}NO_7K_2.2\frac{1}{2}H_2O$ $\quad$ $C_{16}H_{11}NO_7HK$
$C_{16}H_{11}NO_7Ca.1\frac{1}{2}H_2O$ $\quad$ $C_{16}H_{11}NO_7Cu_3(OH).\frac{1}{2}H_2O$
$C_{16}H_{11}NO_7Ag_2.\frac{1}{2}H_2O$ and $C_{16}H_{12}NO_7Ag.C_{16}H_{13}NO_7.H_2O$

The acid forms a compound with hydrochloric acid, and is obtained from its solution in the latter in slender yellow needles, $C_{16}H_{13}NO_7HCl.2\frac{1}{2}H_2O$. The acid is easily converted into the mononitro derivative, $C_{16}H_{12}(NO_2)NO_7$ (melting point 215°) by treatment with nitric acid, dilute as well as concentrated, and by nitrous acid in acetic acid solution. Papaveric acid heated in a stream of hydrogen at a temperature (235°) a little above its melting point, loses 1mol. CO_2, and is converted into pyropapaveric acid, $C_{15}H_{13}NO_7$. The chief product of the fusion of the acid with potassium hydrate is protocatechuic acid. Lastly, the author isolated from the products of the oxidation of the papaverin by permanganate an acid (*d*) $C_8H_5NO_6$, melting at 249°, and identified as α-pyridinetricarboxylic acid. The following statistics are given of the yield of these several products: From 264·5grm. papaverin an aggregate of 100·3grm. of crystalline products was obtained, from which were isolated—

	Grm.
(*a*) Dimethylprotocatechuic acid	9·9
(*b*) Hemipic acid	6·8
(*c*) Papaveric acid	40·2
(*d*) α-Pyridinetricarboxylic acid	12·0
Oxalic acid	12·4

In conclusion, the author applies these results to the discussion of the constitution of papaveric acid, regarded as the immediate product of the oxidation of papaverin, and as yielding by further resolution the products *a*, *b*, *d*. The experimental evidence is summed up by the constitutional formula—



which the author adopts as the working hypothesis for further investigations.—C. F. C.

Adulteration of Tartar. Ziurek. Rep. Anal. Chem. **5**, 245.

Tartars, which are sold in powder, are sometimes adulterated with alum, usually to the extent of about 20 per cent. In four samples, examined by the author, the quantities estimated were 20·6, 26·7, 5·4 and 22·9 respectively. Indications of this adulteration are afforded by the percentage of water which in the normal product does not exceed 2 per cent., whereas in the adulterated article it may amount to 8—10 per cent. If this indication is confirmed by the sulphuric acid reaction, the alumina should be determined, after igniting the specimen.—C. F. C.

Identification of Alkanet. H. W. Vogel. Rep. Anal. Chem. **5**, 245.

The author points out, in reference to a recent communication of J. Herz (*Ibid.* 210), that the colouring matter of the alkanet is most easily identified by the characteristic absorption spectra of its solutions. The solution in amyl alcohol gives the best results. On adding ammonia, the three bands, in the blue green, give place to two, situated one on either side of the D line. —C. F. C.

Improvements in the Manufacture of Chloroform and Acetic Acid or Purified Acetates. From Gustavus Michaelis and William Turner Mayer, New York, U.S.A. Eng. Pat. 8523, July 1, 1885.

This invention claims the process of producing chloroform and valuable residual products, by subjecting crude acetates to dry distillation at high temperatures, removing the fluid products, and subjecting them to the action of hypochlorites, condensing the chloroform therefrom and subsequent purification. Also the production of acetic acid or acetates from the residuals. The invention is based on the discovery that when a crude acetate, as of lime, is subjected to dry distillation, only very small quantities of acetone ($CH_3CO.CH_3$), boiling at 56°, are formed, whilst very considerable quantities of dimethylacetal $C_2H_4(OCH_3)_2$ boiling between 60° and 65°; ethylmethylacetal $C_2H_4(OC_2H_5)OCH_3$, boiling at about 85°; methylethylketone ($CH_3.CO.C_2H_5$), boiling between 75° and 80°; diethylketone ($C_2H_5.CO.C_2H_5$), boiling between 75° and 85°; metacetone $C_6H_{10}O$, boiling between 82° and 86°, and other still higher boiling ketones, as dumasin and other liquids, together with a large quantity of an apparently oily substance, which also holds some of the before-stated ketones in solution, are the result of the process. The further discovery that while pure acetone yields when distilled with a hypochlorite 33 per cent. of chloroform, the above enumerated ketones and other liquids, all of which possess higher boiling points than does acetone, will yield, when freed from water and treated with a hypochlorite, chloroform in the large and unprecedented quantity of measure for measure.—T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Detection and Estimation of Iodine. E. H. Cook. J. Chem. Soc. (Trans.), 1885, 471.

On adding hydrogen peroxide to a solution acidified with acetic acid, and containing chlorides, bromides and

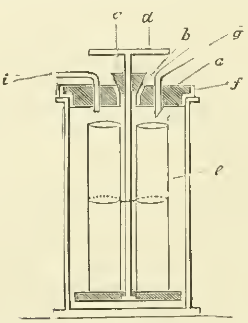
iodides, only the iodine is liberated in the free state, and the separation gives very good results when used for quantitative determinations, as the results show.
—G. H. B.

Colorimetric Method for Determining Small Quantities of Iron. A. Thompson. J. Chem. Soc. (Trans.), 1885, 493.

THIS method is an application of the reaction between ferric salts and thiocyanic acid, and is available in presence of large quantities of most other metals to estimate minute quantities of iron. Mercuric chloride must be absent. The substance to be examined is dissolved in a suitable acid, and the solution evaporated to expel excess of acid. After oxidation of ferrous to ferric iron by the addition of a permanganate solution, potassium thiocyanate is added, and the colour produced is compared with that obtained with known quantities of iron. Figures are given to show the degree of accuracy obtainable.—G. H. B.

An Apparatus for Fractional Distillation under Reduced Pressures. A. Gorboff and A. Kessler. Ber. **18**, 1363.

THE authors describe a modification of Konovalow's apparatus (*Ber.* 17, 1535), which may be employed for large quantities of substance. In the diagram *a* is an ordinary cork, well paraffined and encircled by an indiarubber ring *f*, to make it quite air-tight. The indiarubber cork *c*, through which the glass rod *d* passes, fits into



a glass tube *b*, which passes through *a*. The end of the distillation apparatus is represented by *g*, and connection with the pump is effected by the tube *i*. If the glass rod is well greased, it may be readily turned, even at so low a pressure as 16mm., so as to bring each receiver in turn under the tube *g*.—S. Y.

Apparatus and Arrangements of the Dresden Laboratory. Walther Hempel. Ber. **18**, 1434.

(1.) *Laboratory Filter-Press.*—The filter proper consists of two perforated porcelain plates, between which is a thick indiarubber ring, perforated with one hole to admit a glass tube, which conveys the precipitate and wash water into the filter. The glass tube is connected with an upright glass tube, two or three metres long, and provided at the top with a funnel into which the precipitate and liquid, and afterwards the wash-water, are poured. The filter rests on two slabs of glass, supported by an iron frame, the lower edges of which rest on a split glass tube, forming a trough through which the filtrate runs, and falls into a beaker placed below and at one end of the slightly sloping trough. When the apparatus is to be used the porcelain discs are separated, on one of them is placed in succession a piece of coarse linen suitably cut, a filter paper, the indiarubber ring, a second filter paper, another piece of linen, and finally the second porcelain disc. The filter is pressed together by iron screws covered with indiarubber, and the discs are protected from the screws by pieces of wood or hard rubber. The glass tube at first passes well into the filter, but after the precipitate has formed a moderately coherent cake, it is withdrawn as far as the indiarubber ring, leaving a canal. The wash-water fills this canal and penetrates the whole of the precipitate. The indiarubber rings should be kept under water when not in use.

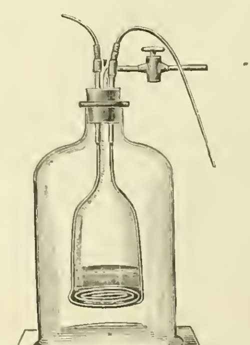
(2.) *Draught for Poisonous Gases.*—In place of the ordinary large and somewhat dark draught chambers, the author makes a long narrow orifice in the wall of the chimney, and places above this a sloping glass plate, supported by T-shaped iron pieces. The evaporating basin or other vessel is placed below the glass roof, and the vapours are carried away by the current of air.

(3.) *Apparatus for Preparing Hydrofluoric and Hydrofluosilicic Acids.*—The author employs cast-iron vessels in preference to lead or platinum. The apparatus consists of a flanged pot and cover, which are held together by four screw-clamps. In the centre of the cover is fitted an iron gas-pipe, 30mm. wide, at the upper end of which is a three-way piece, open at the top, and leading at the side to a lead tube, to which it is connected by a flange. The tube may be closed at the top by a cork. The lead tube passes to the absorption apparatus, which is a lead cylinder 15cm. wide and 70cm. high, closed at the top by a perforated lead basin, and fitted at the bottom with a leaden exit tube. A narrow lead tube passes down one side of the cylinder, forms a coil at the bottom and passes up the other side. By allowing a current of water to circulate through this the apparatus is kept cool. The cylinder above the coil is filled with pieces of charcoal. The mixture of fluor spar and concentrated sulphuric acid is heated in the iron pot by a naked flame, and the gas passes into the cylinder, in which it is absorbed by water which is placed in the perforated basin at the top, and moistens the charcoal. Pure ammonium fluoride is prepared by dividing the crude acid into two portions, neutralising one with ammonia, and then adding the other. The liquid is evaporated in a platinum basin, and allowed to crystallise. For hydrofluosilicic acid the lead delivery-tube is replaced by a glass one, which dips under water. If a tube 15mm. wide is employed, mercury may be dispensed with.

(4.) *Oxygen Apparatus.*—This was seen by the author in New York, but he could not discover the inventor. It resembles the apparatus for hydrofluosilicic acid, but the upper end of the three-way tube is connected with a large funnel fitted with a stopcock. 50grm. of potassium chlorate at a time are shaken through the funnel into the pot which is heated by a naked flame. The stopcock is closed when a glowing taper is rekindled in the funnel.
—S. Y.

Vacuum Desiccator with Appliance for Heating. R. Anschütz. Ann. **228**, 305.

THE apparatus illustrated by the accompanying drawing, serves to heat a liquid contained in a vacuum desiccator



without affecting the vacuum. The heating arrangements consist of a thin lead pipe, both ends of which are

passed through a cork fitted into the neck of the bell jar. A glass tube communicating with the air pump and vacuum gauge also passes through the cork. The lead pipe is rolled together to form a spiral, both sides of which are covered with nickel wire gauze. This forms a portable bed for the substance to be dried. The heating agent is then allowed to circulate through the pipe. —D. B.

On the Volumetric Estimation of Nitrogen. H. Hufschmidt. Ber. **18**, 1441.

THE author finds that the results given by Dumas' method are always too high owing to the air given off on heating the sodium bicarbonate or manganese carbonate, and he recommends the use of marble and hydrochloric acid heated nearly to its boiling point, which gives better results even than sodium carbonate and sulphuric acid. With marble three litres of carbon dioxide were found on an average to contain 0·2cc. of gas unabsorbed by caustic potash. In an analysis the author passes about three litres of carbon dioxide to drive out the nitrogen, and subtracts 0·2cc. from the real volume of nitrogen. A modification of Zulkowsky's nitrometer is recommended.—S. Y.

A New Method for the Volumetric Determination of Sulphur. N. Klobukow. Ber. **18**, 1861.

THE process has for its object the estimation of the total amount of sulphur in all compounds which can be decomposed by acids. It is based on the fact that hydrogen *in statu nascendi* converts under certain conditions sulphur and sulphur dioxide into sulphuretted hydrogen, which can be determined by titration with iodine. The method is carried out in the following manner:—The substance to be tested is put into a flask which is connected with a hydrogen apparatus and an absorbing arrangement. It is also fitted with a separating funnel which supplies the acid necessary for the decomposition. The absorbing arrangement consists of a spacious flask, through whose neck a glass tube reaches down to the bottom, and which holds standard iodine solution and two Liebig's potash bulbs, one containing iodine solution and the second potassium iodide solution. After bringing the weighed substance or measured solution into the decomposing flask, water and granulated zinc, free from sulphur and arsenic are added, and hydrogen passed through the apparatus for about 10 minutes. The acid is then allowed to flow gradually from the separating funnel into the decomposing flask. Either of two cases may now occur; either sulphur dioxide is given off along with the appearance of a precipitate of elementary sulpur, or no sulphur is precipitated. In the first case the flask is cooled by being placed in a dish with cold water, while the decomposition is carried on very slowly. The liquor which is at first turbid gradually becomes clear. The cooling is then discontinued, more acid is added, and the flask gently heated until all the zinc is dissolved. The heat is then raised to 70—80° C., the current of hydrogen increased to produce agitation until all traces of sulphuretted hydrogen are driven into the absorbing flask. If no elementary sulphur is separated in the decomposing flask, the cooling can be dispensed with. If the substance originally contained sulphuric acid or this acid was formed during the decomposition, it will be found in the decomposing flask, and can be estimated in the usual manner.—S. H.

Remarks on the Analysis of Potassium Permanganate and Manganese Peroxide by means of Hydrogen Peroxide. G. Lunge. Ber. **18**, 1872.

IN a former paper on "New Applications of the Nitrometer" (*Journ. Soc. Chem. Ind.* 4495) the author recommended the decomposition of permanganate of potash by means of hydrogen peroxide in excess, whereby the oxygen given off represents double the amount of active oxygen in the permanganate. Martinon (*Bull. Soc. Chim.* 1885, 355) states that a precipitate of manganese peroxide is formed on adding acid hydrogen peroxide to neutral permanganate or neutral hydrogen peroxide to acid permanganate. Consequently according to the latter $6KMnO_4$ and $9H_2O_2$ give off $9O_2$, whereas according to Lunge, $6KMnO_4$ and $15H_2O_2$ act upon each other, generating $15O_2$. Lunge now shows that the precipitate of manganese peroxide can be avoided, if sufficient sulphuric acid is present and the hydrogen peroxide is in excess, and is added all at once. If these precautions are observed, the analysis of permanganate by hydrogen peroxide and by ferrous sulphate give identical results. A further argument that Martinon's reaction does not take place is furnished by the fact that manganese peroxide in acid solution reacts with hydrogen peroxide, thus: $MnO_2 + H_2O_2 = MnO + H_2O + O_2$. On this reaction Lunge bases a manganese peroxide test by means of the nitrometer which is very accurate, can be done in very little time, and requires no balance, or weights, etc. —S. H.

Diphenylamine and Crystallised Phenol as Reagents for Nitrates and Nitrites. H. Hager. Chem. Centr. **16**, 586, 588.

DIPHENYLAMINE has been used as a test for nitrates and nitrites in concentrated sulphuric acid for several years. The author, however, has modified the method so as to render it sharper. He uses the diphenylamine in two forms—the one is a solution consisting of 1grm. diphenylamine dissolved in 30cc. absolute alcohol, the other is a mixture of this solution with five or six times its volume of pure concentrated sulphuric acid. Oxidising agents —*e.g.*, chromic acid, manganic oxide, ferric oxide, arsenic, iodic, chloric, tungstic, and molybdic acids, the salts of these substances and chlorine gas also produce a blue colouration, whilst manganous and ferrous salts, arsenious and oxalic acids if present may hinder the formation of the blue colour. The method of testing is as follows: —About 1cc. of pure concentrated sulphuric acid is poured into a reagent cylinder, and three to four drops of the diphenylamine solution added and well mixed. On to the surface of this is gently poured 3 or 4cc. of the solution to be tested; the blue colour will be produced at the junction of the two liquids if a nitrate or nitrite be present. If the liquid to be tested be first introduced into the cylinder, and the diphenylamine sulphate solution be poured gently down the side of the tube, it will sink to the bottom of the vessel, and will be completely coloured blue. This last method gives better results than the first. One drop of 30 per cent. nitric acid in 60cc. of water gives a distinct dark blue colouration. With smaller quantities of nitric acid, if no blue colouration is obtained, the two liquids are mixed by agitating the cylinder, and an additional quantity of sulphuric acid gently added, and the whole allowed to stand for 30 minutes. One drop of 30 per cent. acid in 200cc. of water can be detected in this way. If chlorine be present the author then uses phenol in the following way:—To a few cc. of the suspected liquid 2 to 3cc. of 25 per cent. hydrochloric acid are added, and then a few crystals of phenol, and the mixture heated to 80 or 90° C. After cooling (?) 1 to 2cc. of concentrated sulphuric acid are gently poured down the sides of the cylinder, when at the junction of the two liquids a bright red colour will be produced. This phenol reaction can be used in the presence of ferric salts, arsenic acid, etc.—S. R.

Diphenylamine, a Valuable Reagent for Detecting Free Chlorine. H. Hager. Chem. Centr. **16**, 588.

DIPHENYLAMINE furnishes even a more delicate test for free chlorine than it does for nitric and nitrous acids. A solution of diphenylamine sulphate is prepared by taking 1 volume of a 3·3 per cent. diphenylamine solution in absolute alcohol, and mixing with it 5 volumes of pure concentrated sulphuric acid. Four to five cubic centimeters of the liquid to be tested for chlorine, are poured into a test glass or cylinder 1cm. wide, and then so much of the diphenylamine solution is added, that after being cautiously poured so as to glide down the inside of the cylinder, it collects in a layer at the bottom. According as there is more or less chlorine present, the upper part of the layer of diphenylamine sulphate solution becomes instantly, or in the course of

a minute, coloured blue. Even with very small traces of chlorine, not detected with iodised starch paper, the reaction is evident. For very small traces of chlorine it is rendered more delicate still if 3 or 4cc. of the solution to be tested are poured into a test tube, and then some 1 to 1·5cc. of the diphenylamine sulphate solution are so added that the liquids form two layers. If the tube be suddenly agitated to cause complete mixing, a strong blue colour is at once formed, which only momentarily appears, and then vanishes. During the agitation a piece of white paper is held obliquely to the cylinder, so that the momentary appearance of blueness may be readily perceived. Suppose even on agitation no reaction ensue, then about 1cc. of pure concentrated sulphuric acid should be run down the side of the cylinder so that it collects on the bottom, and forms a layer. The slightest trace of chlorine will now manifest itself by the sulphuric acid becoming blue. Traces of free bromine are not detected by the diphenylamine test.—W. S.

Influence of Boric Acid on some Colour Reagents. A. Joly. Chem. Zeit. **9**, 779.

Boric acid does not effect a change in the colour of the dye helianthin, tropæolin OO, or orange No. 3 (Poirrier). The author therefore recommends the use of a standard solution of borax for the titration of acids instead of normal alkali.—D. B.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

10750 A. Langdon, London. Improvements in apparatus or means for utilising heated air as motive power. September 11

10764 H. C. Patterson and R. Miller, Glasgow. Improvements applicable to steam-boiler and other furnaces. September 11

10805 J. Murrie, Glasgow. Improvements in apparatus for indicating temperature or pressure. September 12

10893 G. F. Redfern, London—Communicated by L. Evesque and M. H. Fontés, France. An improved apparatus for automatically registering and recording high temperatures. September 14

10907 J. Murrie, Glasgow. An improved apparatus for separating vapours from liquids. September 15

10942 J. B. Alliott, London. Improvements in filter-presses and in apparatus connected therewith. September 15

11036 A. Pople and R. Mogg Bryant, London. A new composition for preventing and removing incrustation in steam boilers. September 17

11271 E. W. Killick, London. Improvements in kilns. September 22

11467 J. Pickering, Walton, Liverpool. Iron-jacketed hot-air furnaces for heating drying chambers. September 26

11842 J. Gray, Glasgow. Improvements in centrifugal machines for separating liquids of different specific gravity. October 5

12189 A. Gapper Southby and F. Delacourt Blyth, London. Improvements in the mode of and apparatus for making ice and pumping highly rarefied condensible vapours. October 13

12195 W. P. Thompson, Liverpool—Communicated by A. Backus, jun., United States. Improvements in or appertaining to furnaces. Complete specification. October 13

12310 J. Gwynne and D. Home Morton, London. Improvements in or pertaining to centrifugal pumping machinery. Complete specification. October 15

II.—FUEL, GAS, and LIGHT.

10778 H. E. A. Wallis, London. Improved construction and arrangement of apparatus for conducting gas flame heat to hydrocarbon containing vessels for increasing the brilliancy or lighting power of coal gas. September 11

10781 G. A. Schoth, London. Improvements in and connected with apparatus or appliances for mixing air with coal and other gas or vapour, and the utilisation thereof for lighting purposes. September 11

10967 E. Coniston Mills, Altrincham. Improvements in apparatus for mechanically feeding fuel into furnaces. September 16

11188 T. Lowe, Old Radford. Purifying waste gas-lime and restoring for use again, for purifying gas and other purposes, and for utilising the products. September 21

11190 G. Pettigrew, Darlington. Improved arrangement of hydraulic main ascension pipes, and anti-dip valve for the manufacture of gas. September 21

11268 W. Barraclough, London. A new and improved method of producing from kerosene oil of any density flame (producing light and heat) to be emitted through a burner without the aid of a wick for use in lamps, stoves, and heating apparatus, and improved apparatus for the purpose of effecting the same. Complete specification. September 22

11358 R. Barker and H. B. F. Barker, London. Improved apparatus and appliances for consuming oils for the generation of steam, boiling of liquids, and like purposes, specially applicable to burning crude or unrefined liquid hydrocarbons. September 23

11359 R. Barker, London. Improvements in means for heating furnaces for smelting or roasting. September 23

11406 J. F. Smith and G. Duxbury, Leicester. An improvement in apparatus for heating all classes of public and private buildings. September 25

11520 R. Walker, Sunderland. Making and manufacturing compound fuel. September 28.

11646 F. Ducher and A. Serraillier, London, and T. Piéplu, Paris. Producing light and heat by means of an apparatus to which we give the name of hydrocarburator. September 30

11661 J. Foord and W. W. Paddon, London. Improvements in obtaining light and heat by the combustion of hydrocarbons, and in apparatus to be employed for this purpose. September 30

11713 H. Howell, Liverpool. Improvements in apparatus for manufacturing illuminating gas from volatile liquid hydrocarbons. October 1

11911 P. C. Bunn, London. Improvements in the preparation of oxides of iron, for use in gas purification, or for other purposes. October 7

12124 W. Smith, London. A new fuel. October 12

12129 G. E. Davis, London. Improvements in the manufacture of illuminating gas. October 12

12187 S. C. Joyce, W. Smith, and W. Neall, London. Patent non-charring wicks. October 13

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

12059 M. Beaumont Parrington, London. Improvements in coke-ovens and in doors for the same, and for other furnaces. October 10

12298 H. Stier, Zwikau, Saxony. An improved process of extracting from carboniferous materials the products met with, the processes of converting into gases and of withdrawing gases (for instance, process of distilling, of smouldering, and the like). Complete specification. October 15

IV.—COLOURING MATTERS and DYES.

10834 H. H. Lake, London—Communicated by Wirth & Co., for Leonardt & Co., Germany. Improvements in the manufacture of colouring matters. September 12

10937 H. J. Haddan, London—Communicated by F. Bayer and Co., Germany. Improvements in the process of manufacturing paranitro-benzaldehydes. September 15

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

10756 J. Smith, Jersey. Improvements in machinery for decorticating fibrous substances. September 11

11053 O. W. G. Briegleb, London—Communicated by H. Plaisier, Holland. Improvements in treating rhea or rameh. September 17

11129 J. Kenyon, London. A stiffening finish for crapes of all kinds, as silk, or silk and cotton, or cotton crape, also for linen, lace, or calico. September 25

11561 G. Kassner, London. A process or manner of manufacturing caoutchouc, wax, fat, colouring matter, vegetable fibre, fibre wool, and cattle food from lactucarious plants, or from plants or vegetables bearing milky juice, or from their extracts, such as opium, lactuca, and their likes. September 29

11660 G. F. Redfern, London—Communicated by E. Frémy and V. Urbain, France. Improvements in obtaining and treating fibres from the barks of plants of the Urtica family, and the like. Complete specification. September 30

11892 H. J. Haddan, London—Communicated by J. Breuer, France. Machinery for decorticating ramie and other textile plants. October 6

12044 G. F. Redfern, London—Communicated by C. de Bailliencourt, France. Improvements in or applicable to machinery or apparatus for treating flax, hemp, and other textile materials. Complete specification. October 9

12055 W. H. Greenwood, Bradford. Improvements in apparatus for washing wool and other fibres. October 10

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

12002 J. Robertshaw, Manchester. Improvements in machinery employed in dyeing, sizing, and wringing hanks. October 9

12159 S. Smithson, Bradford. An improved method of and apparatus for dyeing. October 13

VII.—ACIDS, ALKALIS, AND SALTS.

10801 J. Ballantyne Hannay, Glasgow. Improvements in obtaining ammonia or its hydrochloride, and in apparatus therefor. September 12

10812 G. F. Redfern, London—Communicated by J. Walckenaere, Belgium. Improvements in treating acid vapours from chemical works. September 12

10849 J. Ray Hill, Bury. Improvements in the recovery of alkali and utilisation of by-products. September 14

11151 J. Milligan, London. Improvements in the manufacture of calcined magnesia. September 19

11178 P. A. Mawdsley and T. Macfarlane, London. Improvements in the manufacture of sulphur from alkali waste by means of metallic chlorides. September 19

11219 F. G. Riley, London. Improvements in and relating to apparatus for generating carbonic acid gas. September 21

11492 J. Brock and E. Saye, London. Improved means or apparatus for distributing or conveying acids or other liquors to the cisterns or tanks of chemical towers or to vats or other receptacles. September 26

11512 T. H. Cobley, Dunstable. Improvements in the manufacture of vitriolised ash, and application of same to useful purposes. September 28

11747 R. Fullarton, Glasgow. Improvements in the utilisation of alkali waste. October 2

12132 S. Bowen Bowen, London. Improvements in apparatus for the concentration of sulphuric acid. October 12

VIII.—GLASS, POTTERY, AND EARTHENWARE.

11084 H. Venables, London. A new or improved method of glazing china, porcelain, earthenware, and parian. September 18

11208 A. Landier and C. Houdaille, London. An improved mode of decorating objects of glass, crystal, or ceramic ware. September 21

11351 J. Slater, London. Improvements in ornamenting glass, china, or other vitreous surfaces. September 23

11395 A. Dixon Brogan, Glasgow. Improvements in the manufacture of plate glass, and in apparatus therefor. September 21

11431 A. Shaw, Hanley. An improved process to be employed in printing with metallic substances, such as gold, silver, and similar substances, in a liquid state, for ornamenting or decorating glass, porcelain, china, and fictile substances generally. September 25

11589 A. M. Clark, London—Communicated by La Société Appert Frères, and La Société Geneste—Herscher et Cie., France. Perforated glass, and processes and apparatus for manufacturing the same. September 29

11681 W. Jones, London. Improvements in means for drying bricks and other articles of clay, porcelain, terra cotta, or earthenware, such improvements being applicable for drying purposes generally. October 1

11728 H. Fitzroy Webb, Birmingham. Improvements in the manufacture of decorated glass ware. October 2

11961 E. Powell, F. Bishop, J. W. Bishop, and J. Stonier, London. An improved manufacture of ivory porcelain. October 8

11965 E. Powell, F. Bishop, J. W. Bishop, and J. Stonier, London. Improvements in the manufacture of ornamental porcelain and earthenware. October 8

12128 E. Lee, Leeds. An improved method of ornamentation of glass and other substances. October 12

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

10761 C. Smith, London. Improvements in facing tiles or plates for concrete constructions. September 11

10884 J. T. Welch, London. Improvements in the manufacture of bricks, pipes, tiles, household utensils, and other kinds of pottery goods. September 14

10934 R. Stone, London. Improvements in the manufacture of cement, and in machinery or apparatus in connection therewith. September 15

11001 W. Hassal, London. An improved composition or cement specially applicable for use in jointing stoneware, concrete, or like pipes. September 16

11098 R. Stone, London. Improvements in the manufacture of cement. September 18

11174 J. Watson, London. Improvements in the manufacture of cement. September 19

11270 E. W. Killick, London. Improvements in the manufacture of cement. September 22

11282 J. Howie, Glasgow. An improvement in the manufacture of bricks, tiles, and slabs. September 22

11285 J. W. Ludlam and S. Smith Harvey, London. Improvements in fire and sound proof flooring. September 22

11462 C. Walton, London. Improvements in machinery for making and pressing clay and other material into bricks, tiles, and other forms or shapes. September 26

11549 J. Parker, Glasgow. Improvements in the manufacture of fireclay bricks. September 29

11790 J. Lewthwaite, London. Improvements in paving and the preparation of blocks to be used in part therewith. October 3

11806 W. T. Timewell, London. Improvements in the manufacture of cement. October 3

12118 G. Mingay Garrard, London. Improvements in machinery and apparatus for the manufacture of tiles. October 12

X.—METALLURGY, MINING, ETC.

10816 C. Bernard Holland, London. Improvements in annealing thin sheets and plates of iron and steel, and in furnaces suitable to be employed therein. Complete specification. September 12

10910 A. J. Boult, London—Communicated by H. M. Pierce, United States. Improvements in the reduction of ores and obtaining the metal therefrom by the utilisation of waste gases from carbonisation of vegetable matter. Complete specification. September 15

11067 W. Beatson, Rotherham. An improved process for recovering tin from waste tinned iron. September 18

11280 D. Davis, London. Improvement in means or apparatus employed in coating metal plates with tin, terne, or other metals or alloys. September 22

11311 J. Robb, Dundee. Improvements in the methods of and composition for case-hardening metals. September 23

11361 T. Williamson, Wishaw, N.B. Improvements in apparatus for treating iron and ores, etc., and for making steel therefrom. September 24

11367 T. Williamson, Wishaw. Improvements in cupolas for smelting metals, ores, etc. September 24

11402 B. Howarth Thwaite, Tranmere. A method of decarbonising, desiliconising, dephosphorising, desulphurising fluid iron metal from blast furnaces or from cupolas, and apparatus therefor. September 25

11427 W. P. Thompson, Liverpool—Communicated by L. Imperatori, Germany. Improvements in the purification of iron by the basic process, and in obtaining by-products therefrom. September 25

11499 J. S. Sellon, London. Process and means for soldering aluminium. September 26

11538 A. M. Clark, London—Communicated by C. Cholat and F. Mercier, France. Improvements in and apparatus for treating and purifying cast-iron for the manufacture of iron and steel. September 28

11621 E. R. Blundstone, London. The utilisation of waste tin, tin-plate, lead, and terne-plate. September 30

11689 C. M. Pielsticker, London. Improvements in the production of metal wire, tubes, and the like, direct from the molten metal, and in apparatus connected therewith. October 1

11753 R. Evans, London. Improvements in machinery or apparatus for use in pickling and swilling metal plates. October 2

11798 O. Imray, London—Communicated by L. Bondy, Austria. An improvement in the process of extracting wrought iron and steel directly from ores. October 3

11802 A. J. Maskrey and W. Jones, Glasgow. Improvements in the manufacture of tin and terne-plates, and in coating other articles with tin. October 3

11854 B. D. Healey, Liverpool. Improvements in the method of making steel, and in apparatus therefor. October 6

11873 R. W. Taynton, London. An improved bath for annealing steel. October 6

12110 K. Küpfer, London. Process and compound for welding cast-steel or wrought-steel in bars without heating to a white heat with steel or iron, and for regenerating the welded steel. October 12

12141 H. Brunner, Liverpool. Improvements in or relating to the treatment of phosphatic slags for the recovery of valuable materials therefrom. October 12

12243 T. Childs Huntington and M. Chiapponi, London. Improvements in effecting the extraction of silver from ores, alloys, or compounds containing the same. October 14

12244 T. Childs Huntington and M. Chiapponi, London. Improvements in effecting the extraction of antimony from ores or compounds containing the same. October 14

12265 A. Fehlen, London. Improvements relating to the dephosphorisation of iron ore and to the production of phosphate of soda and phosphate of ammonia. October 14

XI.—FATS, OILS, AND SOAP MANUFACTURE.

11590 A. Twistleton Hall, London. Extracting oils from certain waste products. September 29

11616 A. Wilkinson, London. Improved compounds or compositions for cleansing and polishing. September 29

11726 W. Marriott and H. Marriott, Halifax. An improved process for improving or increasing the viscosity of oils. October 2

11744 T. McGuffie, Liverpool. Improvements in apparatus for cutting bars of soap into lengths. October 2

12305 R. Livesey, London—Communicated by Dr. Duncan, Russia. Improvements in liquid soap. October 15

XII.—PAINTS, VARNISHES, AND RESINS.

10838 A. J. Ward, London. Improved compound or body for the manufacture of pigments, applicable also to the purposes for which white or red lead is ordinarily used. September 12

11129 G. L. Wigg, M. Steele, and W. J. Wigg, Liverpool. Improvements in plant or apparatus to be used in the treatment of residuals from copper works and chlorine manufacture to obtain pigments and sulphate of iron. September 19

11177 O. Imray, London—Communicated by Dr. E. A. Behrens, Germany. Improved process for bleaching and refining resins and similar substances. September 19

11210 A. M. Clark, London—Communicated by W. E. Harris, United States. An improved process for making metallic paint from lead. September 21

11529 E. L. Kitchingman and A. Andrews, London. An improved waterproof and anti-corrosive composition suitable for coating ships' bottoms, and such like purposes. September 28

11543 G. W. Carr and J. Dickenson, London. An anti-fouling composition for protecting and preserving ships' bottoms and other submerged surfaces, applicable also for coating metal, wood, and other underground surfaces. September 28

11639 R. Oliver and J. H. Craven, London. A composition to be applied to bright metallic surfaces to prevent rust or oxidation of the same. September 30

12219 S. Banner, Liverpool. A new or improved substitute for turpentine. October 14

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

11283 J. J. Flitch and J. R. Flitch, London. Improvements in emery wheels employed in the manufacture or preparation of leather. September 22

11284 J. J. Flitch and J. R. Flitch, London. Improvements in the means or apparatus for staking or grounding leather, also for perching or softening the same. September 22

11861 A. Hitchon, Accrington. Improvements in boiling size under steam pressure. October 6

11880 J. Wass Davies, London. The industrial utilisation of leather waste. October 6

12302 H. England Howe, London. An improved method of rendering leather used for the outer soles of boots and shoes more durable and pliable and proof against damp. October 15

XIV.—AGRICULTURE, MANURES, ETC.

10800 S. Deadman Cox, London. An improved process and apparatus for the treatment of coarse and inedible fish, broken fish, and the refuse from fish-curing establishments for manurial purposes. September 12

11609 R. Nicholls, London. Improvements in the mode of fixing ammonia and other gases for manurial and other purposes, and in apparatus employed therefor. September 29

11836 N. Barrett Powter, London. An improved process of treating phosphatic earth or rocks for the purpose of rendering the phosphoric acid available as a plant-food. October 5

12231 J. Davies, Manchester. Improvements in and in the manufacture of fertilising compounds. October 14

12312 W. R. Lake, London—Communicated by G. Stollwerck, Germany. An improved method of and apparatus for causing the germination of barley and other cereals. October 15

XV.—SUGAR, STARCH, GUMS, ETC.

10836 J. Ramsay Woodburn, St. John's, Canada. Pulverising sugar and other friable substances to an impalpable powder, called "Woodburn's pulveriser." Complete specification. September 12

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11671 J. Bagnall, Manchester. Improved means of dissolving vulcanised indiarubber and indiarubber compounds. October 1

11899 G. S. Baker, London. Improvements in machines for baking sugar, wafer cakes, and the like. Complete specification. October 6

XVI.—BREWING, WINES, SPIRITS, ETC.

10949 E. Fielding, London. An improved apparatus for automatically regulating the flow of wort and other liquids from coolers or like vessels. September 15

11935 W. S. Squire, London. Improvements in the manufacture of yeast. October 7

11970 W. P. Thompson, Liverpool—Communicated by C. Ordonneau, France. Improvements in the production of alcohol. October 8

12035 G. G. Picking, W. Hopkins, J. Dore and J. Dore, London. Improvements in the manufacture of vinegar. October 9

12036 G. G. Picking, W. Hopkins, J. Dore and J. Dore, London. Improvements in the manufacture of spirits. October 9

12058 W. S. Squire, London. Improvements in the manufacture of yeast. October 10

12239 J. Hayes, London—Communicated by H. Hackmann, Bavaria. An improvement in the production of malt. Complete specification. October 14

12294 T. Webb, London. The principle of heating wash before entrance into the analysing column of distilling apparatus. October 15

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

(A) *CHEMISTRY OF FOODS.*

11489 J. D. Treharne, London. An improvement in the manufacture of tea by combination with the cocoa-leaf. September 26

11663 S. Fulda, London. Improvements in preserving fruit, vegetables, and analogous productions from decay, deterioration, and discoloration; and in preserving the sugar held in suspension therein from granulation. September 30

11884 J. A. R. Main and J. Dick, Glasgow. Improvements in apparatus for withering and drying leaves of plants, seeds, and analogous substances. October 6

(B) *SANITARY CHEMISTRY.*

10823 J. McIntyre, jun., London. Improved appliances for disposing of sewage in bulk. September 12

10879 C. T. Kingzett, London. Improvements in the treatment and utilisation of sewage. September 14

11038 E. Davenport Latham, London. Improvements in means or apparatus for deodorising or purifying the gases escaping from sewers or other chambers, receptacles or channels. September 17

11115 E. Maxwell Dixon, Glasgow. An improved process for purifying refuse waters from mines, public works, and other sources. September 18

11255 G. R. Keeling, Epsom. Destroying bad smells and noxious gases in sewers, and efficiently ventilating them by the action of fire in flame or by heat-producing substances. September 22

11436 C. T. Kingzett, London. Improvements in the treatment and utilisation of sewage. September 25

11491 J. Scurrah Randles, London. Improvements in the treatment of sewage, town refuse, and other foul substances. September 26

11716 M. Holt, London. Improved means for ventilating sewers, and deodorising sewage gas. October 1

11750 T. Mercer, Liverpool. Improvements in disposing of sewage so as to prevent the pollution of rivers, and in plant or apparatus therefor. October 2

11996 F. M. Knight, Halifax. Improvements in filters, and in the arrangement and combination of ingredients, or filtering medium employed therein. October 9

12206 E. Edwards, London—Communicated by J. Buisson, France. Improvements in apparatus and appliances for purifying and cleaning water in canals or other watercourses. October 13

12261 J. Hanson, London. Process and means for disinfecting, deodorising, and purifying sewage and other foul waters or matters. October 14

(C) *DISINFECTANTS.*

10876 E. Burges Watson and H. Brock Fulton, London. Improvement in the preparation of hygienic and disinfecting substances, and use of the same, as candles, night-lights, and such like. September 14

11988 J. L. Sabunjie, London. Disinfecting and deodorising purposes, consisting of the combination of soap with permanganate of potash, "Crown perm. of pot. soap." October 8

12060 E. Foster and W. H. Bibby, Preston. An improved disinfecting, deodorising, and fumigating powder. October 10

12238 A. Boake and F. G. Adair Roberts, Stratford. Improvements in disinfectants. October 14

XVIII.—ELECTRO-CHEMISTRY.

11153. E. J. Fraser, San Francisco. Improvements in treating wines and liquors with electricity, and in an apparatus for the purpose of carrying out the same. September 19

11224 M. Humm, London. Further improvements in electric baths. Complete specification. September 22

11652 T. J. Jones and W. H. Tasker, London. Improvements in the manufacture of plates or elements for Voltaic batteries. September 30

11876 T. V. Hughes and C. R. Chambers, London. Improvements in the manufacture of carbon filaments for electric lighting. October 6

11879 J. Tatham, London. Improvements in the manufacture of metal-covered electrical conductors, and in apparatus therefor. Complete specification. October 6

12001 J. Swinburne, Brockley. Carbons for electric lamps. October 9

12063 F. S. Fowler, Haslemere. Sodic bichromate constant current electric battery. October 10

XIX.—PAPER, PASTEBOARD, ETC.

10919 E. Davies, C. F. B. Birchall and A. Wood, London. Improvements in the manufacture of paper-pulp, and in apparatus therefor. September 15

11550 J. Napier and T. Graham Young, Glasgow. Improvements in apparatus and methods for treating with chemical agents vegetable substances capable of yielding pulp for paper-making or other useful applications. September 29

11948. H. J. Rogers, Watford. An improved process for renewing the worn surfaces of strainer-plates for straining paper-pulp, and apparatus used therefor. October 8

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

11258 D. D. Cattanach, London. Improvements in the method of and apparatus for the manufacture, distillation, and concentration of alcohol, hydrocarbons, and acetic acids. Complete specification. September 22

XXI.—EXPLOSIVES, MATCHES, ETC.

10825 O. Imray, London—Communicated by C. E. Birchel, Germany. Means of packing, storing, and applying liquid explosives. Complete specification. September 12

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11432 R. Punshon and the Patent Oxonite Company, London, Improvements in cartridges for blasting and other purposes. Complete specification. September 25

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11809 W. Bruce Thomson, Wick, N.B. An improvement in the manufacture of matches. October 5

12228 Erskine H. B. Stephenson, Clapham. Improvements in the use of chlorate mixture in cartridges. October 11

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1885.

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8787 H. J. Allison—Communicated by A. G. Day. Vulcanised kerite compounds, and processes for the manufacture of the same. 4d
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SECOND EDITION.

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1884.

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XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

(A) *CHEMISTRY OF FOODS.*

1884.

15778 E. Fontenille. Process for refrigerating and congealing liquids. 6d

(B) *SANITARY CHEMISTRY.*

1884.

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8661 W. Wood and M. H. Hurrell. Apparatus for refining copper and other metallic mattes by electrolytic and chemical actions. 6d.

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1884.

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1884.

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THE JOURNAL

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES

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ERRATUM.—In the last number of this Journal, page 576, 2nd column, line 14, the price of bromine is stated as 35s. per lb. Read 35 *cents, or 1s. 6d. per lb.*

London Section.

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MEETINGS, SESSION 1885—86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

December 7.—Dr. P. F. Frankland on "Some Aspects of Filtration and other Methods of Water Treatment." Dr. F. L. Teed—"Note on the action of Calcium Carbonate on Solution of Ammonium Chloride."

January 4, 1886.—Mr. G. E. Davis, F.I.C.—"On the Enrichment of Coal Gas by certain Hydrocarbons." Mr. C. T. Kingzett—"Notes on Russian Turpentine."

February 1.—Mr. Gustav Bischof—"Notes on Dr. Koch's Water Test." Mr. J. W. Westmorland, A.R.S.M.—"The Estimation and Valuation of Copper Ores and Products for Commercial Purposes."

March 1.—Mr. Boverton Redwood, F.I.C.—"Viscosimetry." Mr. T. B. Lightfoot, M.I C.E., M.I.M.E.—"Ice Making and Cooling Machinery."

April 5.—Professor Unwin, M.I.C.E.—"The Principles and Methods of Testing Cementing Materials."

May 3.—Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy — "Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, October 26, 1885.

MR. D. HOWARD IN THE CHAIR.

HEATING REGENERATIVE GAS-FURNACES BY RADIATION FROM FLAME.

DISCUSSION.

THE CHAIRMAN commenced the proceedings by referring to the loss the Society had sustained by the death of the former Chairman of the London Section—Mr. Walter Weldon, F.R.S.—to whose memory and labours he paid a fitting tribute. Passing to the subject which was to occupy the attention of the members that evening, he said they were exceedingly fortunate in having amongst them the distinguished author of the paper which was heard with so much pleasure at the annual meeting of the Society in July; and he hoped the result of the discussion would be to throw some light on the practical application of the physical questions involved in the production of heat, which were of no little importance in these days of modern chemistry. He could not help thinking that they hardly appreciated how very much chemistry had to learn from the physicist—how much, in particular, with regard to the question of the full development of the force stored up in coal they had yet to learn. To say that in these days there was nothing more important than real economy in fuel was a mere truism; but, unless they could call in the aid of such men as Mr. Siemens, it was difficult to see how the resources which Nature had placed at their disposal could be thoroughly developed. They knew the theoretical power which ought to be obtained from 1lb. of coal, and they also knew (or perhaps a great many did not know) how much they fell short of this in practice in furnaces and boilers. There was before the physicist a vast field of improvement in the economy of coal, which might bring about a revolution quite as great as that produced by Watts's discovery of the steam-engine. He had great pleasure in asking Mr. Siemens to make any prefatory remarks he might feel inclined to offer; and he hoped all the members had taken an opportunity of carefully studying the paper, and would be fully prepared to discuss it, and show their appreciation of the importance of the problem before them.

MR. F. SIEMENS: I may commence by explaining that, when I first altered the chambers of my furnaces so as to work by radiant heat, I had no scientific motives in view; I simply wished to improve the manner of working and the capabilities of my factory. I looked at the matter with the eye of a manufacturer who wanted to increase and cheapen production, and to improve the articles produced; to solve scientific problems was no part of my intention at that time. That is the reason why I worked this new system in my own establishments abroad for some time before publishing it. After having made considerable progress in the development of the invention at my Dresden glass works, heavy duties were imposed on glass entering Austria, and as I exported a large proportion of the products of my Dresden works to that country, I was compelled to construct new works in order to avoid paying the duty. I selected Neusattel, near Karlsbad, in Bohemia, as the locality for those works, and however regrettable it might be to me, from a manufacturer's point of view, to have to invest capital in their construction, they afforded me the opportunity of making further trials, as it is easier to design new furnaces to effect a special purpose than to alter old ones. These works came into operation in 1878, and although I obtained from the new furnaces improved results upon those obtained at Dresden, I did not yet see my way to take out patents, owing to the circumstance that the conditions involved in the new method of heating, as at that time practised, could only be explained from a scientific point of view, and that German patents are strictly limited to features of construction. Moreover, I desired to make further trials, and I felt sure of keeping the secret of the invention to myself, owing to the difficulty which would be experienced in discovering it from the outward appearance of a furnace. I was confirmed in this view by the consideration that the principles involved in my new furnace were directly opposed to the old notions of furnace construction and of combustion. But a few years later, after the gradual enlarge-

ment of my new works at Neusattel, and the construction of additional furnaces at Dresden and Doehlen, the experience obtained enabled me to mature my invention and to determine the features of construction essential to its success. This was about the time I took upon myself to carry on the work of my late brother, Sir William Siemens, and I determined to apply for patents and to publish the invention. The first memoir on the subject was the paper which I read before the Iron and Steel Institute, at Chester. On that occasion I kept strictly to the practical details of the furnace, leaving out theoretical questions altogether. I explained how, in order to bring about radiation, the flame was conducted through the furnace in such a way that it does not touch any part of the surface, either of the roof, sides, ports, or bottom, but is able to radiate heat freely in the chamber, and then go through the ports into the regenerators to deposit its remaining heat there by contact. In the first part of the operation the flame acts by radiation, in the second part by contact; this, as is shown by innumerable publications and descriptions of furnaces and systems, is the contrary of what has always been observed; there has always been a tendency to contract furnace chambers to the smallest possible size, and to bring the flame into contact with the side of the furnace and with the material to be heated; and where, on rare occasions, an exception has been made on account of the material which was to be operated upon not admitting, for some reason, of being touched by the flame, it was always explained why such a divergence from ordinary practice was necessary. During the discussion of my paper at Chester I described the theoretical part of the system, which has been taken up with great interest, most of the technical journals, and the writers for those journals, approving of it, some, however, having objected to it; and what surprised me was, that the principal objections were made on theoretical grounds, and ignored all the practical results, treating my work as mere scientific conjecture. On the whole, I am not at all dissatisfied with the opposition that has been raised against my new method of heating, and it was only what I could expect, as it interferes with many well-accepted arrangements and old-established views which will not be readily given up, although it can be shown that by supplanting them great practical results are obtained. Some have objected against the system that it is not new, because high roofs have been in use before. To this it may be answered that there is hardly anything new in form; the only question is with what intention a certain arrangement has been chosen. If, as has been the case, anyone says that he has seen furnaces with high roofs before, I can only ask him for what purpose such high roofs were adopted. There are various reasons which may induce a furnace builder to construct a high roof; besides, a high roof forms no part of my system, but it is only one of the means I employ to conduct the flame through the furnace-chamber in such a manner that only radiant heat comes into action there. If the high roof has not been selected for that purpose, and the flame continues to strike down on the bed of the furnace, such furnaces cannot be considered as constructed according to my system. I am still awaiting the production of any publication which shall show that furnace-chambers have ever been constructed in the same manner and for the same purpose as those described in my paper. Hitherto nothing has been brought forward to prove that my new method of constructing and working gas-furnaces has in principle been anticipated, even in the slightest degree. The scientific grounds on which objection has been made to my system were simply with regard to the laws of the dissociation of flame. It was maintained that it was utter nonsense to talk of accumulating heat in the way I described, because, when a certain temperature was arrived at, dissociation set in, and at such a high temperature no further combustion took place; so that however perfect the combustion might be, no advantage would be gained, because a certain temperature could not be exceeded. I could only set against this argument the fact that I was always able to increase the temperature, the only limit being the heat-resisting power of the material of which the furnace was built; so far I have not fonnd any material sufficiently refractory to withstand the intense heat that may be obtained in the radiation furnace; but I think that further experiments I am making with that object in view will result in the production of a material more suitable for furnace building than any hitherto used. I have found that when furnaces, on the other hand, had small chambers, and the flame played directly on the sides, the inner walls, the arch, and the hearth, then certainly the heat did not rise to the same extent. This is a state of things which some call "dissociation;" but I attribute it to "imperfect combustion," brought about by the action of the surfaces. When the flame strikes in the immediate neighbourhood of the arch of a furnace, or of any solid material, the combustible gases cannot burn—they want elbow-room, as it were. After studying the question of dissociation, and the experiments which had been made, I came to the conclusion that the whole theory of dissociation of flame is not yet perfectly developed, or at least that no system of furnace construction can be fairly criticised from the dissociation point of view. I found that dissociation in an open space can only occur at a very intense temperature—so high, in fact, that we cannot reach it—and consequently it need not enter into any of our calculations of furnace building, always supposing that there is free space for the gas to burn in. On the other hand, most of the apparent cases of dissociation recorded admit, to my mind, of another explanation. It is the indirect influence of the inner surfaces of the apparatus employed which, in many cases, accounts for the appearance of dissociation. There are some experiments which prove this very clearly. I shall only refer to the experiments of eminent authorities, from which you will see that dissociation is always brought about by surface action. Bunsen established dissociation in the following manner:—He filled a tube with carbonic oxide and oxygen just in the right proportions to burn. He ignited it by some means, and produced an explosion; but he found that only one-third of the gases took part in this explosion, and the other two-thirds remained unburnt. He obtained, however, a temperature (according to his calculation) of 2400° C. Now, Bunsen relates that when he allowed a certain interval to elapse, so that the tube might cool down perhaps to 1000° C., he could produce with a portion of the remainder of the gas another explosion; the heat rose again, and the limit of explosion was again touched, so that no further combustion could take place. After cooling it a second time he produced a third explosion, and found that most of the combustible gases were cousumed. Now, Bunsen says—and it seems very plausible—that, at a temperature above 2400° C., the gases do not enter into combustion, and that if you could raise the temperature higher by some artificial means, dissociation would set in, and the burning gases would separate. I would offer another explanation of these results, and this I am bound to do, to agree with the facts of combustion which I have proved to exist in regenerative furnaces worked by radiation. I am of opinion that only one-third of the gases filling the tube had sufficient space in which to burn; the other two-

thirds were too near the circumference of the tube; they adhered to the sides, or struck on the sides, and consequently remained unburnt. When, however, a short time had elapsed, the gases mixed again by diffusion; the portion next the sides moved towards the centre of the tube, and then another explosion could take place. Again waiting for this diffusion to do its work a second time, a third explosion was possible. According to this theory, the heat had nothing to do with the result, but only the influence of the sides. Now, to prove the correctness of my inference, I would refer to the experiments on dissociation of some Russian scientists, Menschutkin and Konswalow, which quite confirm my views; they found that if the vessels in which the experiments were made had roughened surfaces, or contained sand, asbestos, or ground glass, there was considerable dissociation. This just proves what I have said, that where there is a rough surface the combustion is more difficult, more sluggish, and cannot take place so readily. I wonder these gentlemen call this action "dissociation," as it would appear to be the influence of surfaces that brought it about. To some extent this is also corroborated by the evidence of the father of the dissociation theory, Deville. In his book he describes innumerable experiments which he made to prove dissociation by heat; but he says, at the same time, that he requires porous tubes. He has to employ material of various kinds, which he puts into the tubes he uses, and shows that much depends on the material he employs. Besides, there is a very curious circumstance which goes still further to prove what effect surfaces have. Deville proved dissociation of carbonic acid by producing carbonic oxide and oxygen; but he also dissociated carbonic oxide itself, producing carbonic acid and carbon. So that two directly opposite effects are supposed to be produced by the same means—viz., by the action of heat; but it seems quite impossible to conceive how heat could at one time produce dissociation of one kind, and at another time of another kind; at one time dissociate carbonic acid, with the production of carbonic oxide and oxygen, and at another time dissociate carbonic oxide, and make carbonic acid and carbon. There are other scientific men who have experimented on dissociation; for instance, Victor Meyer, who dissociated water by dropping melted platinum into it. Melted platinum has a high temperature, and he thus produced steam which was dissociated into oxygen and hydrogen. But the influence of platinum on hydrogen is well known; it condenses it, even so far as to set fire to it. Why, then, should it not be instrumental in bringing about dissociation? The same thing occurs, to a less degree, when steam is passed through a platinum tube heated from the outside. Meyer (who, by the way, disputes the correctness of Menschutkin's results) thus obtained signs of dissociation; but, of course, the heat inside the tube when heated in this way will not be very great, and the steam passing through the tube would not have much heat imparted to it, so that in this case the heat would be so small, that in spite of the presence of the surface of platinum, he only had traces of dissociation. He also obtained traces by passing carbonic acid through a platinum tube. It must not be forgotten that platinum has also an influence on oxygen; it is oxidised, and consequently it may be instrumental in bringing about this dissociation. It seems to me that it must be so, because the heat conducted to anything passing through a tube which is heated from the outside is so small in quantity and intensity as not to be sufficient in itself to produce dissociation; the heat, in fact, would be of a lower temperature than any flame we have. All that I have said tends to show, therefore, that in furnace building dissociation may be left almost entirely out of consideration. It is only in cases where furnaces have very small chambers, so that the flame comes in contact with surfaces, that the appearance of dissociation might take place. I have given you my theory of dissociation, and brought it into harmony with my system of furnaces, and I think I am right in my view. But I do not pretend to be an authority on scientific matters, and would rather leave these questions to scientific authorities to determine the right theory. Here (referring to a model) is a furnace which is supposed to be a portion of a boiler flue worked by radiation. The flame passes through the boiler tube without touching it, and gives its heat to the boiler by radiation. In returning, the flame has to play on the surface of the boiler, and heat it by contact. As long as the flame is in a state of active combustion, it should not touch any surface; but, after the combustion is completed, contact is necessary. I have such boilers at work; they do not make a particle of smoke, and there is a great saving of fuel, of the boilers themselves, and of furnace material. (Mr. Siemens then explained various diagrams, exhibited when his paper was read, showing the construction of furnaces; and also showed the regenerative gas stove, which he exhibited and described at the meeting of the Gas Institute in June last.) Mr. Siemens then went on to say that an English fire-place is a very healthy arrangement, as it gives out radiant heat only. The only drawbacks to it are the smoke produced and the mess of coal, ashes, and soot, which ought to be done away with. The stove exhibited in action is made with the view to increase radiation of heat; it is supplied with a regenerative burner producing intense heat, and consequently it has great heat radiating power. Gases which have passed through the combustion stage act in much the same way as air, which cannot radiate out heat if it is ever so hot, because it is not a solid body. I can give you the results of some experiments which I have made with my brother, Dr. Werner Siemens, who heated air to try whether it would radiate light, and it does not, even if ever so hot. If any light is radiated it is simply from particles of dust in the air, or some other solid matter which is suspended in it. These radiate heat, and emit light when heated, but air itself does not do so. In the gas-stove exhibited, the products of combustion going down behind the flame pass into a regenerator, which heats the air that is brought up for combustion. The heat of the products of combustion is given up by contact to the regenerator, which heats the air by contact, and the hot air, in combining with the gas, produces the intensely-hot and bright flame which has such high heat and light radiating power, thus the remaining heat of the products of combustion is not lost, but is used to increase the heat radiating power of the flame. This stove burns something like 14 cubic feet of gas an hour, about the consumption of two to three ordinary burners, and for any moderate sized room this would be quite sufficient. If this stove were used it would entirely abolish smoke, and, being a gas-stove, there could be no ashes or soot produced.

The Chairman said the main practical question involved was how far radiant heat, or how far direct-acting flame was the more economical. On the other hand, there was the very interesting scientific question of the heat—the dissociation of flame; both of which points were well worthy of very careful consideration.

Professor Armstrong said he had been greatly interested in hearing Mr. Siemens's remarks on the subject of dissociation, and felt very much inclined to take his side on this question. Attention had

been specially called to the influence which surfaces had in promoting dissociation. He certainly agreed with Mr. Siemens in thinking that probably many of the results which had been obtained were not purely heat effects, but that the surface employed had a great deal to answer for. With regard to the experiments referred to, in the first place, one was inclined now to look at this matter from a somewhat different point of view from that taken by Bunsen, since the publication of Mr. H. B. Dixon's work, which had clearly shown that the combustion of carbonic oxide and the behaviour of carbonic oxide and oxygen mixtures were largely dependent on the amount of water vapour present; so that conclusions drawn from such experiments as those made by Bunsen were practically not of any great value. With regard to the Russian experiments referred to, there was also some doubt, as they had been altogether called in question by Victor Meyer. One would like to hear some discussion on the very important question raised as to the effect of incandescent solid matter. If he understood Mr. Siemens rightly, the whole radiant effect of a flame was due to the presence within it of incandescent solid particles. This certainly was a most important point. If the efficiency depended, as had been maintained, on obtaining the chief amount of heat-energy in this way, then the point to which attention had been called was of extreme importance; the method of heating described entirely depended on the acceptation of this theory. With regard to the beautiful burner exhibited, he could not help remarking that Mr. Siemens must do something before he introduced it into London. He must first help to get a better gas supply; for, practically, at the present time, they were not in a position to use such burners, because the Gas Companies supplied gas of such quality that the first thing it did was to close its own passage-way. The South Metropolitan Gas Company especially were, at the present time, engaged in trying to block up their own mains. They were using ordinary Newcastle coal alone, and the result was that the gas was highly charged with naphthalene, but contained nothing to prevent it being deposited; and, on cold weather coming on, it rapidly stopped up the main and service pipes.

Mr. Siemens said it was quite correct that, in his opinion, radiation only proceeded from the free carbon in the flame. If there was only carbonic oxide gas or hydrogen in the flame, there would be little radiation; but even these gases should be burnt in an open space before being brought into contact with surfaces to avoid loss of effect, as when flame acted directly on brickwork, combustion was very imperfect. What was called "dissociation" would set in; but, according to his views, it would be imperfect combustion. To work a furnace by radiant heat to the best advantage, fuel containing the largest proportion of hydrocarbons, or, in other words, gas from the coal generally met with, should be used.

Professor Huntington said this subject seemed to divide itself into two questions—the practical aspect, or the heat-value of Mr. Siemens's furnace, and the theoretical question as to where the maximum limit of heating power was to be found. With regard to the theory, he did not think it was worth very much. True theory could only be the result of perfect practice; and when they had the practice perfect it was time to formulate a theory. At present they had not sufficient results to enable them to formulate a theory; they could only frame working hypotheses to give direction to further investigation. With regard to the practical aspect of the question, it was difficult to carry on any discussion at present, because these furnaces, although being worked on a very large scale, were in the hands of Mr. Frederick Siemens and those associated with him; and, in order to discuss the matter, it would be necessary that they should be working in different places under different conditions, so that they might be compared. He could only say, in regard to the furnaces themselves, that he saw them working about a year ago at Landore, and was greatly struck with them. The first thing about them was their remarkable simplicity, which would give them a much longer life. The work could be carried on without stopping to make repairs. As far as he could judge, the temperature obtained in the Landore furnaces was all that Mr. Siemens claimed. All furnaces were heated partly by radiation and partly by contact. Mr. Siemens's furnace was an improvement in the direction of heating by radiation. With regard to dissociation, it always appeared to him that the results obtained by Bunsen and Deville were very far from finality. If he recollected rightly, they obtained the commencement of the dissociation for the aqueous vapour, for carbonic oxide, and for carbonic acid between 1100° and 1300° C.; but he had never yet heard that anyone had claimed to have ascertained the point at which complete dissociation took place. They had it on the authority of Deville that, when hydrogen was burnt in an equal volume of oxygen, he obtained 2500° C. under the conditions of the experiment; but this, so far as he (Professor Huntington) was aware, was the only statement on the point. No one had given anything conclusive to show the point at which the whole of the gases would undergo dissociation. In fact, Deville had pointed out that the tension of dissociation was to be defined on parallel lines with vapour tension, and that just as water would be converted into vapour at ordinary temperatures, so gases would undergo dissociation at a point very much below the temperature which would be obtained by the combustion of the constituents. It was evident, therefore, that the subject was quite an open one.

Professor Armstrong said it was very interesting, in connection with this subject, to recollect that it had been shown that at a temperature not far below 2000° C., carbon dioxide did not undergo any change, whereas carbon monoxide decomposed to an appreciable extent, and water also was decomposed below this temperature.*

Dr. Squire said Mr. Siemens had called attention to the fact that the surface in a tube over which gases were passing favoured dissociation. He would remind him that surface in the same way favoured combustion. It was very well known that certain substances (such as oxide of iron, clay, and some others) would promote the combustion of particular gases; so that there was at the same time a cause which would produce dissociation and also combustion. With regard to the temperature, for example, at which oxygen and hydrogen were dissociated, one could hardly expect to fix this, because, in a great many cases, the presence of the gas affected the decomposition of the material. He had himself found that it was perfectly impossible to saturate ordinary air with sulphur; as the two could not be made to combine. A certain percentage of sulphurous acid could be arrived at; but one could not get any further, however high the temperature was raised. But the presence of other gases very much affected the tendency to combine, or the decomposition of the

* *Note added during revision by Dr. Armstrong.*—I find that I overstated the temperature, which was only about 1700°. It is noteworthy, however, that, whereas, according to Meyer and Langer, carbon dioxide passes unchanged through a *platinum* tube at this temperature, Meyer and Züblin have confirmed Deville's observation that it is decomposed to an appreciable extent at 1300° when passed through a *porcelain* tube filled with fragments of porcelain.

substance in question. If gases acted more or less as vacua to one another, then also the products of decomposition, as well of decomposition going on, would materially affect the temperature of dissociation. One obtained a certain result, and could not go any further at this temperature. If the temperature went a little higher, there was a sort of partial decomposition. He would suggest to Mr. Siemens whether it was absolutely certain that his theory of the effect of contact was absolutely proved under these circumstances.

Mr. E. Dowson said the question of heating boilers in this way by gas was very interesting, and the chief point appeared to be that the flame should not be allowed to come in contact with the boiler-plates, because this lowered the temperature by reason of the contained water; and they were told that this imperfect combustion and consequent loss of heat might be avoided by not letting the flame come in contact with the plates, and by using only the radiating power of the flame and the conducting power of the products of combustion. In principle this was doubtless correct; and the more nearly it could be followed in practice, the less loss of heat would there be, and the less nuisance from smoke. At the same time it must be remembered that the exigencies of construction and space required the greatest heat to be produced with a minimum surface exposed; and he had some fear that such a system as this could hardly be applied with advantage where such a concentration of heat effect was necessary. At any rate, he should be glad to hear Mr. Siemens's views on this point. Where a boiler was heated by gas drawn from a producer, there was no incandescent mass of fuel, but only the flame and the products of combustion to heat the boiler with; and it was, therefore, no doubt of the greatest importance that the best possible treatment of the flame should be correctly understood. They had to seek not only a flame of high radiating power, but also one capable of giving up its heat by conduction rather than by radiation. With this point in view, he would ask Mr. Siemens if he would kindly state whether he had obtained any economic advantages by applying his system to a boiler of ordinary construction. It would be extremely valuable if he had data derived from experiments on one boiler with the three systems of firing to which he had referred—(1) heating with solid fuel, (2) heating with gaseous fuel with contact, and (3) heating with gaseous fuel without contact.

Mr. Siemens said so many questions had been asked that he could hardly answer each separately. He could only say that for the last ten years he had used no other fuel than gas, and that the results obtained by the new method of heating are to be compared with those formerly obtained by the old method of heating by gas. There was always a great advantage in using gas as fuel if it were well managed; there was not only the saving in fuel, but also a very great saving in labour. There was also great economy in the wear and tear of furnaces and material of all kinds, but if they worked with gas they required to use it constantly. If it was employed in the daytime and not at night, there would be a loss, but if there was application for the gas both during day and night, it was very economical. He only used radiant heat as long as the flame radiated out heat; as soon as the visible flame ceased he brought the gases into contact with the surfaces he wanted to heat, for when combustion ceased, then the gases might be brought into contact with anything as they had no injurous effect. It was only the active flame which injured surfaces, not by its heat, but by the excessively rapid motion of the gases. Surfaces upon which a flame played were always roughened, and he took this to prove the destructive action of the flame which no material could stand for any length of time. In attempting to use an active flame, and to abstract the heat by contact, a double injury was inflicted; the heat that might otherwise be produced was lowered, and the material with which the flame was brought into contact was destroyed, besides smoke being produced. In using a flame which had little or no radiating power in it there was the same need for a combustion chamber, for the flame should not be allowed to play at once against surfaces or brickwork, as then there would be imperfect combustion. It was the surface itself, not alone its cooling influence, which was injurious to the flame. In heating a boiler it was still necessary, even if they had fuel which did not radiate heat, to provide a combustion chamber.

Mr. Fletcher said there could be no doubt about the efficacy of the radiant heat produced from combustion; for all furnaces were, as a rule, heated entirely by radiant heat. He thought, therefore, they would all support Mr. Siemens's view that it was radient heat after all, which was employed generally when a very high temperature was required. It was chiefly where a low heat was required (such as in a boiler) that the heat of conduction was mainly used. If Mr. Siemens had made experiments on any particular fuels, and could tell the meeting the difference between the heating power of fuel used where the bottom heat only was employed, and where it was so burnt as to develop more particularly the radiant heat, and could give them some figures showing the amount of water evaporated per 1lb. of coal burnt under the two systems, it would, he thought, be very valuable.

Mr. Siemens said he had not paid very much attention to the subject of boilers, and could not give any figures. He had fired his boilers on the new system because he was convinced that it would be a great advantage, and found it was so, for he used from 20 to 30 per cent. less fuel to do the same work as before; and the boilers worked more regularly, had a longer life, and required much less attention. With regard to heating by radiation in chemical furnaces he had already stated that there were cases were radiant heat was used for some particular purposes; but it had been explained in these cases why it was so used, and even then, such furnaces did not work fully by radiation as he had explained it. In the way furnaces were generally constructed the flame struck against anything, and this was just what should be avoided.

Mr. Mactear said it occurred to him that there was one furnace especially in which the principle of radiation was carried out very fully—viz., the old-fashioned regulus furnace which existed on the Tyne as far back as 1822. In this furnace the space above the main part to be heated was very high, but the bridge also was very high, and had a narrow slit, and the flame came over. Being a very small body of flame compared with the mass of the furnace, it floated about almost like a cloud. There was very little draught in the furnace, and the heating was practically all done by radiation from the flame. Mr. Siemens seemed to have taken this principle, and expanded it enormously; and there was no doubt the results he had obtained were of very great importance. He (Mr. Mactear) thought, however, that a good deal of this was due to one fact which had not been touched upon, and that was that for a given consumption of fuel he had enormously increased the size of the combustion chamber. Consequently, the speed of the passage of the gases through this chamber was much retarded, and a longer time given for the combustion of the

gas in the chamber itself. This seemed to him a very important matter, which tended much to the success of the system. With regard to Bunsen's experiments on dissociation, if the question depended, as Mr. Siemens thought (and probably with reason), on the effect of surfaces, and if the combustion of a gas ceased at a certain point, owing to the amount of surface exposed, it would seem a comparatively easy matter to repeat the experiments with tubes of different diameters, and see whether the amount of dissociation differed. This would probably show the effect of surface contact.

Mr. SIEMENS said Mr. Mactear spoke in the same way as Mr. Deville had done. He obtained dissociation, but he wanted all kinds of surfaces to bring it about; and as long as surfaces were wanted there was no saying what influence they had. With regard to the heating of boilers, he did not think the production of steam would be less with radiant heat, but rather more; but if the flame struck against the sides or other surfaces a considerable amount of heat would be lost, because they would get covered with soot, which the heat could not penetrate. Radiant heat, especially with a large body of flame, had always a very powerful effect, because flame radiated heat from the inside as well as from the outside, not like a solid body, which only radiated from its surface. The slowness with which the flame passed through the furnace chamber had a very beneficial effect, as Mr. Mactear had stated, as it allowed the radiant heat more time to act, whilst as regards the heating by contact which took place afterwards, this should be more effective than in an ordinary solid fuel furnace, on account of the higher initial temperature of the flame.

Mr. DOWSON said he thought Mr. Siemens had somewhat modified his original proposition. It now appeared to be that the extra space given in the new type of radiation furnace over the space required on the old type of furnace was only necessary until such time as the combustion of the gas should be complete.

Mr. SIEMENS said that the combustion of the flame should be completed within the heating chamber of the furnace; the resulting hot gases should then be passed into the regenerators where they would give up their remaining heat by contact. In the combustion chamber the flame worked by radiation only; by the heating chamber he meant the combustion chamber in the case of a furnace, and by the flame-flue is meant the combustion chamber of a boiler.

NOTES ON THE CHEMISTRY OF SOAP.

BY C. R. ALDER WRIGHT, D.SC., F.R.S., LECTURER ON CHEMISTRY; AND C. THOMPSON, F.C.S., DEMONSTRATOR OF CHEMISTRY IN ST. MARY'S HOSPITAL MEDICAL SCHOOL.

IT has long been known that when common salt is added to a hot aqueous solution of potassium stearate or oleate, or of both salts mixed, together with larger or smaller quantities of analogous potash salts (such as the products of saponification of tallow, etc.), double decomposition takes place, resulting in the formation of potassium chloride and the soda soap corresponding with the potash soap originally employed; and further, that when neutral potassium or sodium stearate is treated with large masses of water it is partially broken up or *hydrolysed*, forming caustic alkali and an acid stearate, a similar behaviour being also noticeable in the case of analogous salts or soaps containing other fatty acids—*e.g.*, palmitic. We have recently had occasion to study somewhat in detail these and other allied phenomena, and have obtained results some of which it may be of interest to put upon record.

I.—*On the Relative Affinities shown by Alkalis for certain Inorganic and Organic Acids in presence of each other.*

The reaction of sodium chloride upon potassium stearate (or other analogous salt) above referred to has long been utilised for the purpose of obtaining hard soda soaps from soft potash soaps, in localities where the relative cost of potash and soda as saponifying agents has made it more convenient to employ the former alkali to react on the fatty matters used. It is usually regarded as an example of a general rule obtaining in such cases, and also employed in the calculation of analyses of mixed saline matters (such as the salts dissolved in a mineral water), which rule may be thus stated: When no interfering causes (such as relative insolubility) are at work, *the stronger alkali is associated with the stronger acid*, the order of alkaline strength being (1) potash, (2) soda, (3) ammonia. In the case of common salt and a potash soap, the stronger acid hydrochloric acid (which may be regarded as contained in the salt solution) in accordance with this rule tends to associate itself with the stronger base potash, whilst the weaker alkali soda combines with the feebler fatty acids of the soap. Similarly when nitrate of soda and carbonate of potash are brought together, nitrate of potash and carbonate of soda result, the stronger acid nitric acid combining by preference with the potash; this reaction has long been utilised as a means of producing saltpetre from nitrate of soda. The result of our experiments, however, is to show that this rule does not express the whole truth quite correctly. We find that when two alkalis and two acids are simultaneously present, there is a partitioning of each pair, giving rise to four distinct salts, the relative quantities of which depend to some extent upon extraneous circumstances, and are largely influenced by the relative masses of the two alkalis on the one hand, and of the two acids on the other. In certain cases, when potash and soda are the alkalis, the salts formed by the combination of potash with the stronger acid and soda with the weaker one, very greatly exceed in amount the other two salts formed by the combination of potash with the weaker acid and of soda with the stronger one; but by varying the conditions, and more especially the relative masses, these relationships may be greatly modified, and even inverted. For instance, sodium chloride and potassium stearate, when intermixed in such proportions relatively to the water present that the soaps formed are thrown wholly out of solution in the brine, will give rise to a mixture of potassium and sodium stearates as insoluble curd and of potassium and sodium chlorides in the brine, of which salts the second and third contain respectively the majority of the stearic acid and of the potash. But, on the other hand, if potassium chloride and sodium stearate be similarly intermixed in suitable proportions, the soap thrown out of solution will contain the majority of the stearic acid combined with potash instead of soda, and the majority of the soda will be found as chloride in the aqueous brine instead of in the soap, the action indicated by the rule of "stronger acid and stronger base" being thus apparently inverted.*

* In connection with the proportions in which the acids and bases of the two admixed salts will partition themselves so as to form four salts, it may be noticed that the reaction of potassium carbonate upon sodium nitrate really gives rise to four salts, and not to two only, the nitric and carbonic acids being both divided between the potash and soda respectively. That this is so is evident from the circumstance that if sodium nitrate and potassium carbonate in equivalent proportions be mixed, dissolved in water and

In the same kind of way, if caustic potash and caustic soda be mixed and brought into contact with a fatty acid, the latter being in quantity insufficient to neutralise the total alkali present, the rule of "stronger base and stronger acid" would suggest that potash soap would be formed to the exclusion of soda soap, were enough potash present to saturate the fatty acid. In point of fact, however, the product of the action is a mixture of potash and soda soaps, with excess of caustic potash mixed with caustic soda, where the ratio between potash and soda in the combined condition is sensibly the same as that of the uncombined alkalis, and consequently the same as that of the alkalis originally employed; so that in such a case the affinities of the two alkalis are sensibly equal. It is remarkable that practically the same result is obtained with most of the ordinarily occurring fatty acids, the nature of the acid not materially influencing the result. Thus the following numbers were obtained in a series of experiments with pure stearic acid; pure oleic acid; a mixture of stearic and oleic acids, etc., obtained by decomposing a tallow soap with hydrochloric acid; a similar mixture of nearly equal amounts of stearic, palmitic, and oleic acids, obtained from a palm-oil tallow soap; and the crude lauric acid (mixed with lower and higher homologues) similarly obtained from a cocoa-nut oil soap. In each instance the quantities of materials used were, for a given amount of fatty acids, exactly the neutralising amount of caustic potash together with the equivalent amount of caustic soda, so that two equivalents of total alkali were present to one of fatty acid. The alkaline leys being weighed out, the weighed quantities of fatty acids were added, and the whole heated to near 100° in a water bath, without stirring, until the fatty acids were melted, forming a supernatant layer. The whole was then briskly agitated for some time, and finally left at rest (after concentration by boiling down in the case of the cocoa-nut acids), the amount of water present being such that the resulting soaps were wholly insoluble in the alkaline ley; it sufficed to draw off and analyse a portion of the fluid, to obtain the data for calculating what fractions of the alkalis used were respectively converted into soap and left uncombined.

Fatty Acid employed.	Percentage of Total Fatty Acid converted	
	Into Soda Soap.	Into Potash Soap.
Pure Stearic Acid	51·2	48·8
Pure Oleic Acid	50·8	49·2
Crude Stearic and Oleic Acids (tallow)	51·5	48·5
Crude Stearic Palmitic and Oleic Acids (palm oil and tallow)	48·2	51·8
Crude Lauric Acid (cocoa-nut oil)	49·7	50·3
	Mean .. 50·3	49·7

These figures clearly show that for all practical purposes the potash and soda existed in every case half as soap and half as uncombined hydroxide in the mixed mass resulting from the mechanical incorporation of molten fatty acid and two equivalents of caustic alkali, half as potash and half as soda.

It should hence result that if a soda soap be fused and then well intermixed with as much caustic potash as is equivalent to the soda present, or if a potash soap be similarly treated with the equivalent quantity of caustic soda, the final product should be the same in each case—viz., a soap containing half the fatty acids combined with one alkali and half with the other, and an alkaline ley containing equivalent amounts of potash and soda. In point of fact, a close approximation to this result is actually attained in practice. Owing to the mechanical difficulty of obtaining thorough incorporation in experiments with small quantities made in the laboratory, the amounts of potash displaced by soda, or *vice versa*, usually fell a little below 50 per cent., but approached sufficiently near to that figure to indicate that it would have been arrived at with more complete means of admixture. Thus the following numbers were obtained with the tallow-soap acids above referred to, (*a*) when exactly neutralised with potash, and then stirred well with the equivalent amount of caustic soda solution; (*b*) when exactly neutralised with soda and then stirred with the equivalent amount of caustic potash solution—

(*a*) Percentage of Potash Soap converted into Soda Soap	(*b*) Percentage of Soda Soap converted into Potash Soap
48·8	46·0

Similar results were obtained with other fatty acids.

Most remarkably-different results were obtained in a parallel series of observations in which the carbonates of potash and soda were used instead of the hydroxides respectively. In these experiments various fatty acids were exactly neutralised either by caustic potash or soda, as the case might be, and were then well intermixed with aqueous solutions of the carbonate of the other alkali. Finally the mass was dried on the water-bath and treated with strong (nearly anhydrous) alcohol, which dissolved out the soaps and left behind the alkaline carbonates, the reaction invariably giving rise to four products—viz., potash soap, soda soap, potassium carbonate, and sodium carbonate, but in relative proportions widely differing from those observed with the hydroxides—the amount of potash contained in the mass as soap being to the soda similarly contained in far greater proportion than that of the total masses of potash and soda present as carbonates; in fact, when quantities of potassium carbonate were intermixed with soda soaps in proportions not exceeding the amounts equivalent to the soda in the soaps, by far the majority of the potash passed into combination with the fatty acids, equivalent quantities of sodium carbonate being formed; whilst on intermixing sodium carbonate with potash soaps, even in quantities largely in excess of the amounts equivalent to the potash present, only a comparatively small percentage of fatty acids became combined with the soda, forming an equivalent amount of potassium carbonate. Thus the following table exhibits side by side some of the numbers obtained, (*a*) on intermixing

evaporated to dryness, the solid residue is always hygroscopic, or even deliquescent, indicating the presence of more or less unchanged potassium carbonate. Similar results are observed with chloride instead of nitrate.

soda soaps with carbonate of potash, (*b*) on intermixing potash soaps made from the same fatty acids with carbonate of soda. The fatty acids employed were the same mixtures of stearic and oleic, of stearic palmitic and oleic, and of lauric and homologous acids described above, together with the crude ricinoleic acid obtained by saponifying refined castor oil with caustic soda and decomposing with an acid—proportious. A known quantity of fatty acids was divided into halves, and each half converted into neutral soap by addition of caustic potash to the one and caustic soda to the other. The two soaps were then mixed and dissolved in hot water (150 molecules H_2O to 1 molecule of mixed soap—*i.e.*, to $\frac{1}{2}$ molecule of potash soap + $\frac{1}{2}$ molecule soda soap), and treated at a temperature not far from 100° C. with a

Fatty Acids employed.	(*a*) Soda Soaps fused with K_2CO_3. Percentage of total Fatty Acids present.		(*b*) Potash Soaps fused with Na_2CO_3. Percentage of total Fatty Acids present.	
	Equivalent to the K_2CO_3 added.	Actually converted into Potash Soap.	Equivalent to the Na_2CO_3 added.	Actually converted into Soda Soap.
Stearic and Oleic (tallow)	10·1	8·0	—	—
Ditto	45·7	34·4	—	—
Ditto	100·0	97·95	100·0	4·3
Ditto	104·2	99·0	1000·0	15 0
Stearic Palmitic and Oleic (palm oil and tallow)......	57·2	52·1	—	—
Ditto	108·0	90·8	177·0	9·5
Crude Lauric Acid (cocoa-nut oil)	52·8	46·4	—	—
Ditto	111·8	87·9	197·0	6·2
Crude Ricinoleic Acid (castor oil)	50·0	48·4	—	—
Ditto	100·0	93·8	205·0	8·2

These observations throw some light on the effect well known to be produced on the texture and grain of certain kinds of soda soaps when melted and stirred with pearlash solution. The hard soda soap is partially converted into soft potash soap, thus modifying the texture, whilst the carbonate of soda formed as complementary product exerts a "closing up" or hardening action on the mass, avoiding the pastiness and softness that might possibly be caused by the presence of the potash soap when produced in any quantity. It is, however, to be remarked that inasmuch as no neutralisation of the extra alkaline matter thus added takes place, soaps thus subjected to "pearlashing" must necessarily contain "free alkali" to an extent proportionate to the amount of pearlash added, and hence may readily be rendered most objectionably alkaline and deleterious to sensitive skins when this process is adopted. Quantities of free alkali, equivalent to 10 or 12 per cent. of that present combined as soap, are not infrequently met with in "pearlashed" soaps, an amount entirely inconsistent with high quality from the point of view of suitability for application to tender skins.—*Vide* Section III.

It is thus evident that when fatty acids and carbonic acid on the one hand, and potash and soda on the other, are simultaneously present, the prevailing tendency is towards the formation of potash soap and carbonate of soda. Quite the opposite result is brought about if chlorides be substituted for carbonates, the prevailing tendency now being towards the formation of soda soap and potassium chloride; at least these salts are formed in preference to potash soap and sodium chloride when the relative masses of the two alkalis are nearly equal, although by modifying the relative masses the latter pair of salts can be made to be generated in preference to the former pair. Thus the following figures were obtained in a series of experiments carried out in such a way that the total potassium and sodium present were in equivalent mixture of equivalent weights of potassium and sodium chlorides (20 molecules mixed chlorides, or 10KCl+10NaCl) in the state of powder, poured in with continuous agitation kept up for some minutes. The curds that separated were collected after complete cooling (the proportion of water and saline matter being such that no soap then remained dissolved) and well pressed in calico, and finally were dried in the water-bath and boiled with strong alcohol. Small quantities of chlorides were thus taken into solution as well as the soaps, but as the chlorine thus present only represented an amount of alkali equivalent to from 2 to 5 per cent. of that equivalent to the fatty acid dissolved as soap, the error thus introduced was not sufficiently great to affect the general result, which was uniformly this, that between $1\frac{1}{2}$ and 6 molecules of soda soap were contained in the alcoholic solution for 1 of potash soap. Thus with various of the fatty acids and admixtures thereof above described the figures given in the first table on page 628 were obtained, exhibiting considerable variation with the nature of the fatty acid, but always such as to indicate formation of soda soap to a notably greater extent than of potash soap.

In other series of experiments the quantity of sodium present was increased relatively to the potassium, under which circumstances, as might be expected, still larger proportions of soda soap were formed. On the other hand, increasing the amount of potassium present relatively to the sodium, decreased the amount of soda soap and increased that of potash soap until the latter predominated. Thus the figures given in the second table on page 628 were obtained in some experiments in which (*a*) potash soaps dissolved in M molecules of water were salted out by adding N molecules of sodium chloride for 1 molecule of soap; (*b*) soda soaps dissolved in M molecules of water were salted out by adding N molecules of potassium chloride for 1 molecule of soap.

It is thus evident that in the (*b*) series of experiments the soap thrown out of solution was essentially potash soap*—a conclusion borne out by its consistency. It is noticeable, on comparing the figures in the (*a*) and (*b*) columns for each kind of fatty acid, that the tendency to convert potash soap into potassium chloride and soda soap by the action of sodium chloride, is *cæteris paribus*, distinctly more marked than the tendency to convert soda soap into sodium chloride and potash soap by the action of potassium chloride, precisely as might be inferred from the above experiments with equal molecules of potash and soda compounds.

A number of experiments were also made on the mutual reactions of ammonium chloride upon potash and soda soaps, and of potassium and sodium chlorides upon ammonia soaps. In accordance with the rule of "stronger acid and stronger base," it might be anticipated that on adding ammonium chloride to a potash or soda soap the chlorine will combine with the fixed alkali metal, an ammonia soap being the complementary product; the experiments just described, however, would suggest that under certain conditions this action might be inverted, so that on adding potassium or sodium chloride to an ammonia soap more or less potash or soda soap might be formed, together with the equivalent amount of ammonium chloride. In point of fact this is the case; whilst almost complete displacement of fixed alkali from combination with fatty acid ensues when a potash or soda soap is dissolved in 200 molecules of water, and after cooling well stirred with twenty molecules of ammonium chloride; the opposite effect is produced when twenty molecules of potassium (or sodium) chloride is similarly stirred into a cold solution of an ammonia soap in 200 molecules of water, the majority of the fatty acids becoming transformed into potash (or soda) soap, and a corresponding amount of ammonium chloride being formed. It is remarkable in this connection, moreover, that in two experiments, alike in all respects save that potassium chloride is used in the one and the equivalent quantity of sodium chloride in the other, a perceptibly larger proportion of fatty acids becomes converted into soda soap than does into potash soap, indicating a greater tendency for potash to remain as chloride than for soda. Thus the numbers given on page 629 were obtained in four series of observations, the numbers in the four last columns respectively indicating the percentages of total fatty acids employed as soaps converted—

(*a*) From the condition of ammonia soap to that of soda soap by salting out with sodium chloride;

(*b*) From the condition of ammonia soap to that of potash soap by salting out with potassium chloride;

(*c*) From the condition of soda soap to that of ammonia soap by salting out with ammonium chloride;

(*d*) From the condition of potash soap to that of ammonia soap by salting out with ammonium chloride.

Fatty Acid used.	Percentage of Fatty Acid contained		Molecular Ratio of Soda Soap to Potash Soap.
	As Potash Soap.	As Soda Soap.	
Pure Oleic Acid	38·0	62·0	1·63 to 1
Crude Ricinoleic Acid (from castor oil)	17·8	82·2	4·6 to 1
Stearic, Oleic, and Resin Acids, mixed (primrose soap)	17·2	82·8	4·8 to 1
Crude Lauric Acid (from cocoa-nut-oil soap)	15·1	85·9	5·7 to 1

Fatty Acid used	M	N	(*a*) Potash Soaps salted out with NaCl. Percentage of Fatty Acid in Curd.		(*b*) Soda Soaps salted out with KCl. Percentage of Fatty Acid in Curd.	
			As Potash Soap.	As Soda Soap.	As Potash Soap.	As Soda Soap.
Stearic and Oleic Acids (tallow	100	5	10·5	89·5	79·1	20·9
Ditto	200	20	5·1	91·9	82·1	17·9
Stearic Palmitic and Oleic Acids (palm oil and tallow)	200	20	3·8	96·2	95·8	1·2
Crude Lauric Acid (cocoa-nut oil)	200	20	5·4	91·6	74·8	25·2

The ammonia soaps used for series (*a*) and (*b*) were prepared by just fusing the fatty acids and then well incorporating moderately concentrated ammonia solution in quantity slightly in excess of the amount equivalent to the fatty acids, and finally dissolving in water so as to obtain nearly clear solutions; those obtained in series (*c*) and (*d*) invariably decomposed spontaneously during preparation, giving off more or less free ammonia and forming acid ammonia soaps.

On the whole, all the experiments tend to show that when a soap and a neutral salt containing an alkali different from that in the soap are brought together, four salts are formed in relative proportions, largely governed by the relative masses of the two alkalis and the two acids; but there is always a more or less marked tendency for the stronger base and stronger acid to associate themselves together in proportions greater than those deducible from their actual masses relatively to the weaker base and weaker acid. When the salt is carbonate, since carbonic acid is a weaker acid than the fatty acids of soap, the prevailing tendency is (when the alkalis are potash and soda) to form potash soap and sodium carbonate; and when the salt is chloride,

* This conversion of soda soap into potash soap by salting out with potassium chloride does not appear to have been hitherto noticed; at least we have been unable to find any printed record of the observation amongst the voluminous literature relating to soap that has come under our inspection.

since hydrochloric acid is a stronger acid than the fatty acids of soap, the prevailing tendency is to form potassium chloride and soda soap. But these tendencies can be very largely overcome by the action of mass, especially with chlorides.

Fatty Acid used.	Ammonia Soap salted out with— (a) NaCl	(b) KCl	Ammonium Chloride added to— (c) Soda Soap.	(d) Potash Soap.
Stearic and Oleic Acids (tallow)	91·3	71·8	99·0	99·5
Ditto (another specimen)......	—	70·7	—	99·3
Stearic, Palmitic, & Oleic Acids (palm-oil and tallow)	90·3	61·6	99·5	99·7
Crude Lauric Acid (cocoa-nut oil)	86·0	—*	99·5	99·5
Crude Ricinoleic acid (castor-oil)	66·0	—*	99·7	99·5

It is noticeable, on comparing the figures in the (a) and (b) columns, that the tendency of soda to pass from the state of chloride to that of soap is, *cæteris paribus*, more strongly marked than the similar tendency in the case of potash, precisely as might be anticipated from the previous results.

* The potash soaps of cocoa-nut and castor-oils formed could not be separated from the brines so as to permit of analysis.

On the other hand, when only fatty acids are present, and no mineral acid or carbonate, there does not appear to be any marked tendency for either potash or soda to combine with the acid by preference.

	Percentage of NH_3 calculated as dry substance. Stearic.	Lauric.	Oleic.	Ricinoleic.
Freshly-prepared, still moist	6·05	8·30	6·00	5·75
After 2 weeks........ ...	5·00	5·67	—	—
„ 13 „	3·62	4·06	2·52	2·67
„ 26 „	2·36	4·02	0·87	0·46
Calculated for NH_3,HX	5·65	8·02	5·69	5·51
„ NH_3,2HX	2·91	4·18	2·93	2·85

In connection with the spontaneous decomposition of ammonia soaps, the following observations may be of interest:—A number of ammonia soaps was prepared by thoroughly intermixing fatty acids just fused with excess of moderately strong ammonia water, the whole being then dried over sulphuric acid for some months; the mass was pulverised and stirred up occasionally when sufficiently dry, samples being drawn from time to time and submitted to analysis. In all instances it was found that a rapid loss of ammonia took place during the first few weeks, until the composition approached that of a diacid salt, NH_3,2HX (where HX represents the acid), after which the rate of loss became much slower. The temperature during the period of standing over sulphuric acid was rarely as high as 18° C., the substances being kept in an unwarmed room during winter and spring: on further heating the partly-decomposed salts to temperatures not very elevated, a distinct evolution of ammonia took place; whilst after heating for a few hours to 100° C., practically all was expelled and nothing but fatty acids left. The above figures represent the progressive loss of ammonia observed with crude lauric acid (from cocoa-nut oil), pure stearic acid, crude ricinoleic acid (from castor-oil), and nearly pure oleic acid, when converted into ammonia salt containing a small excess of ammonia intermixed therewith; similar results were obtained in various analogous experiments with mixtures of acids. On the whole, it appears that the diacid ammonia salts of the saturated fatty acids (lauric and stearic) lose ammonia distinctly more slowly than the corresponding salts of the unsaturated acids (oleic and ricinoleic).

II.—*On the Amounts of Hydrolysis effected in Soaps with varying proportions of Water.*

The decomposition of neutral soaps by water into acid soaps and free alkali has long been known as a fact, but systematic measurements of the amount of decomposition effected under varying conditions with different kinds of soaps do not as yet appear to have been made. Having recently had occasion to study this point somewhat minutely, we have arrived at a number of figures capable of being expressed graphically as curves, and leading to the following general conclusions:—

(1.) The amount of hydrolysis brought about by the action of a given quantity of water on a neutral soap is variable with the nature of the fatty acid from which the soap is made, but in all cases increases with the amount of water employed relatively to the soap, but less rapidly; so that curves plotted with the amounts of water as abscissæ and the proportions of alkali set free as ordinates are concave downwards.

(2.) Addition of excess of alkali to a neutral soap causes a diminution in the amount of hydrolysis effected under given conditions, to such an extent as completely to stop the action with comparatively small proportions of water when the free alkali only amounts to a fraction—say 20—25 per cent.—of the alkali combined with the fatty acids.

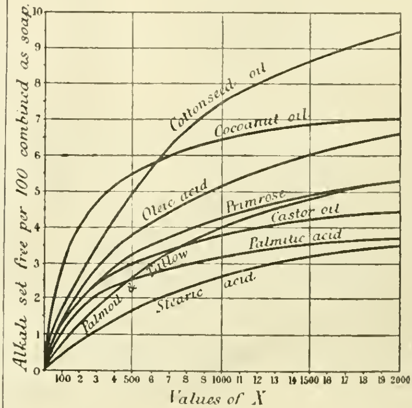
(3.) Alcohol, even when not absolutely anhydrous (90—95 per cent.), does not decompose ordinary neutral soaps into free alkali and acid salts; if, however, water be added to an alcoholic soap solution, more or less hydrolysis is brought about; so that if a gelatinous mass of neutral soap dissolved in strong spirit (containing a little phenol phthalein) be treated with water, a more or less strongly-marked colouration is noticeable as the water diffuses into the mass. (This affords a good lecture illustration.)

The experiments were made as follows:—The soaps examined were either prepared by ourselves or obtained from manufacturers with information as to the fatty acids present; they were carefully analysed, and in those cases where minute amounts of free alkali were present corrections were made for these

small amounts.* Weighed quantities of soap representing known amounts of *anhydrous* soap were dissolved in known quantities of distilled water on the water-bath, and after cooling to near the ordinary temperature the liquids were treated with pure sodium chloride, so as to throw out of solution all, or nearly all, the soap as a curd. The curds thus precipitated, on drying and dissolving in alcohol, were always more or less acid, phenol phthalein being the indicator; so that one way of determining the amount of hydrolysis was to determine the quantity of alcoholic potash or soda solution requisite to neutralise this acidity. It was found, however, in practice to be far more convenient to determine the alkali contained in an aliquot portion of the brine, correcting the amount found for the free alkali originally contained in the soap (when any). With smaller proportions of water the addition of moderate quantities of salt sufficed to throw all soap out of solution so perfectly, that at most only traces of fatty acids could be obtained from the brine by acidulating and shaking with ether; with larger proportions it was found convenient to evaporate the brine until nearly saturated, and filter again from any soap thrown out of solution during the evaporation, using only a fraction of the salt requisite to saturate the water for the salting out, rather than to use more salt in the first instance and titrate without evaporation, greater accuracy in hitting the terminal reaction being thus attained. With cocoa-nut oil soap the brines were evaporated to dryness, and then treated with just sufficient water to dissolve the salt and filtered; in this way liquids free from more than traces of soap were obtained, the soap originally contained in the brine before evaporation being thus eliminated.

The following corrected mean values were obtained in a lengthy series of experiments with various soda soaps, all of which were either neutral or only faintly alkaline; the numbers represent the quantities of Na_2O set free by hydrolysis, reckoned per 100 parts of Na_2O contained in the soap combined with fatty acids, x molecules of water being used for one of anhydrous soap.

of these three homologous acids, that for the acid of highest molecular weight underlying, and that for the acid of lowest molecular weight overlying, the third. It cannot, however, be hence inferred that the soda salts of acids of the fatty series are decomposed by water with the greater ease the lower their molecular weight, for Julius Thomsen's thermo-chemical investigations (*Thermochemische Untersuchungen*, i. p. 372) show that sodium acetate is not measurably broken up by water.



The curve for tallow-resin soap (primrose) indicates that the presence of a certain amount of resin soap in a mixture mainly consisting of sodium stearate and oleate does not materially affect the rate of hydrolysis, since the curve for this soap lies between the stearic and oleic acid curves.

Fatty Acids.	Mean Molecular Weight.	Hydrolysis brought about by x Molecules of Water.				
		$x=150$	$x=250$	$x=500$	$x=1000$	$x=2000$
Pure Stearic Acid	284	0·7	1·0	1·7	2·6	3·55
Nearly pure Palmitic Acid	256	1·45	1·9	2·6	3·15	3·75
Crude Lauric Acid	195	3·75	4·5	5·4	6·45	7·1
Pure Oleic Acid	282	1·85	2·6	3·8	5·2	6·65
Crude Ricinoleic Acid	294	1·55	2·2	3·0	3·8	4·5
Chiefly Stearic, Palmitic, and Oleic acids (palm-oil tallow soap)	271	1·1	1·55	2·6	4·1	5·3
Chiefly Tallow and Resin (primrose)	280	1·5	2·2	3·1	4·2	5·3
Cotton Seed	250	2·25	3·0	5·0	7·5	9·5

The annexed diagram represents these values graphically, the value of X being abscissæ and the others ordinates.

It is noticeable, in connection with these figures, that the curves for stearic, palmitic, and lauric acids (cocoa-nut oil) lie in the order of the molecular weights

* For the determination of the free alkali the soap was dried and boiled with strong alcohol, and filtered hot; the filtrates were always neutral, showing absence of caustic alkali; the trifling residue of carbonate sometimes left on the filter was treated with standard acid in the usual way. *Vide infra*, Section III.

The curves obtained with oleic acid and cotton-seed oil (which appears to contain some amount of an acid analogous to the linoleic acid of linseed-oil) overlie all the others, cocoa-nut oil excepted; ricinoleic acid, however, furnished a soap that hydrolysed markedly less readily than sodium oleate, though more readily than sodium palmitate and stearate.

The following numbers, obtained with some of the above soaps, illustrate the effect of the presence of free sodium hydroxide in diminishing the amount of hydrolysis produced by given quantities of water,

the values being in all cases notably below those obtained as above with neutral soap solutions :—

Nature of Fatty Acids used.	Extra Na_2O added to Solution, per 100 combined as Soap.	Hydrolysis brought about by x Molecules of Water.		
		$x=150$	$x=250$	$x=2000$
Crude Lauric Acid (cocoa-nut)	11·0	1·1	1·6	2·0
Cotton-seed Oil Soap	15·0	nil.	nil.	6·5
Stearic and Oleic (tallow)	20·0	nil.	nil.	nil.
Tallow Resin (primrose)	15·0	nil.	0·1	1·3

Similar results were obtained in numerous other experiments of the same kind.

III.—*Comparative Results yielded by Different Processes in ordinary use for the Determination of "Free Alkali" in Soap.*

In connection with this subject the following notes may be of some interest, being obtained as the result of a large number of comparative analyses made for the express purpose of testing the accuracy of the various methods. Three methods were examined, which for convenience of reference may be designated respectively as the "Alcohol test," the "Fatty Acid titration test," and the "Salting-out test" (or A.T., F.A.T.T., and S.O.T.). The first consists of the following operations :—The soap is dried, and then boiled with a sufficient amount of strong alcohol—or, better, absolute alcohol. The filtrate and washings are then titrated with alcoholic acid or alkali, using phenol phthalein as indicator, so as to obtain the positive or negative alkalinity of the solution (*negative* alkalinity indicating free fatty acid or diacid salt). The residue on the filter, consisting of carbonates, etc., is then titrated as usual, and the total alkalinity taken as the algebraic sum of the two valuations.* A number of direct experiments showed that if a perfectly-neutral soap were taken to start with, dissolved in alcohol, and added to a known quantity of alcoholic potassium or sodium hydroxide, the amount of alkali present was still correctly determinable with phenol phthalein as indicator, the presence of the soap introducing no marked error; whilst, on the other hand, if the same soap were dissolved in water and a known amount of sodium carbonate added, this amount was always sensibly indicated by the alkalinity of the residue obtained by evaporating to dryness, treating with alcohol, and filtering and washing thoroughly ; whence it may be inferred that the A.T., when properly applied to a soap, gives accurate information, not only as to the total "free alkali," but also as to the proportion thereof existing as hydroxide and carbonate respectively. Accordingly, this process may fairly be taken as a standard of comparison for the others.

The second process (F.A.T.T.) consists in determining the total alkali present (that existing as soap together with the free alkali), separating the fatty acids in any convenient way, and finally dissolving these in alcohol and titrating with alcoholic potash or soda with phenolphthalein (or other suitable colouring matter) as indicator. Although at first sight this process would seem likely to be exact, yet in our hands it seemed almost invariably to be affected by a sensible error of uncertain direction.

On testing absolutely-neutral soaps in this way, numbers were obtained sometimes indicating a small positive excess of alkali, and sometimes a small negative one (excess of fatty acids) ; and in the same way, soaps that contained small or moderate amounts of free alkali when tested by A.T. often yielded distinctly different results when tested by F.A.T.T., the difference being sometimes + and sometimes −. As range of variation, from + 3 per cent. of the alkali present as soap to − 3 per cent. of the same usually represented the extremes ; but occasionally still larger discrepancies were observed, whilst concordance within ± 1 per cent. by the two tests was the exception rather than the rule. That no particular systematic error in one direction obtained was evidenced by the fact that taking the average of a long series of duplicate tests with different soaps, the + differences and the − differences sensibly balanced one another. Thus the following figures may be quoted as illustrations, the numbers representing the amounts of free alkali found per 100 combined as actual soap—*i.e.*, if the total alkali were 8·5 per cent. of the soap itself, and the free alkali were 1·0 per cent., then the free alkali would be $\frac{1·0}{8·5—1·0} = \frac{1·0}{7·5} =$ 13·3 per cent. of the combined, and so on.

Nature of Soap.	A.T.	F.A.T.T.	Excess of A.T. over F.A.T.T.
Cotton-seed Oil Soap	7·0	14·0	−7·0
Chiefly from Bleached Palm Oil	5·0	10·8	−5·8
Primrose	1·1	5·0	−3·9
Transparent Soap, made by Spirit Process, containing 10 per cent. of Sugar	0	2·0	−2·0
A Curd Soap (highly alkaline)	18·3	18·1	+0·2
A British Cold Process Soap..	7·4	8·8	+1·4
A Continental Toilet Soap	1·2	−4·1	+5·3
A British ditto	8·0	2·5	+5·5

The four extreme differences here tabulated (first and last pairs of samples) were unusually large, the differences ordinarily not exceeding ± 3·0.

Inasmuch as an uncertainty in the actual amount of free alkali present thus seems to exist when the F.A.T.T. is used, amounting to ± some per cents. of the alkali present as soap, it follows that the F.A.T.T., though convenient and useful in the examinations of various kinds of soap where a sharply exact estimation of the free alkali is not material, cannot be safely used for the purpose of deciding whether the amount of free alkali in, for example, a toilet soap falls beyond a small limiting quantity. Thus in following the classification suggested by one of us in the Cantor Lectures on Toilet Soap, delivered some months ago before the Society

* It is not impossible for a free fatty acid (or, rather, a certain proportion of diacid salt) to coexist side by side with an alkaline carbonate in a solid soap; for example, in a soap prepared by intermixing a free fatty acid with a strong alkaline solution.

of Arts,* the F.A.T.T. is practically useless, inasmuch as it is not possible to affirm certainly by its means whether or not a given sample of soap contains less alkali in a free state than $\frac{1}{40}$th part (2·5 per cent.) of that present as soap. The test might indicate perfect neutrality when upwards of 2·5 per cent. of free alkali is present; or it might condemn a soap as passing beyond the limit of 2·5 per cent. when really the soap might be perfectly neutral. On the other hand, for the commercial valuation of the detergent power of strongly alkalised or silicated soaps where a large portion, or even the majority, of the alkali present is not combined with fatty acids, the F.A.T.T. is often extremely convenient, necessitating but little additional trouble after the fatty acids formed on decomposing with acid have been determined.

The third process (S.O.T.) is usually carried out in much the same way as the experiments above described on Hydrolysis, and consequently is apt to be even more inexact than the F.A.T.T. A certain amount of liability to error could no doubt be avoided by uniformity in procedure—*e.g.*, by always taking such a quantity of water to dissolve the soap in as would represent approximately a constant number of molecules of water to one of soap; but even if sources of error through varying proportions between water and dry soap could be avoided, there would remain the objection that a widely varying excess of alkali is always present in the brine over and above that to be determined, owing to the hydrolytic action of the water; and it is impossible to apply any mean correction sufficiently accurate for use to obtain exact results, because not only is the hydrolysis due to a given amount of water variable with the nature of the fatty acids present, but also it varies for a given fatty acid with the amount of free alkali in the original soap, increase in alkalinity of soap diminishing amount of hydrolysis. The figures on next column may be quoted as illustrations, being some obtained in one series of comparative valuations in which for one molecule of dry soap approximately 150 molecules of water were constantly used (roughly speaking, about ten parts by weight of water to one of dry soap); the soap being dissolved by the aid of heat, the solution was cooled and treated with an amount of pure common salt equal to one-fifth the weight of water, the curdy mass being then filter-pumped, and the last portions of adherent alkaline brine washed out with a few ccs. of saturated salt solution. With soaps largely consisting of cocoa-nut oil salts, an additional error is apt to be occasioned by incomplete precipitation from solution of soap by salt, apart from the increased error due to larger relative hydrolytic action on this class of soaps.

Considerably larger discrepancies between the results of the two methods were observed when relatively larger quantities of water were employed, as, for example, when a solution of soap (two, five, or ten per cent.) was precipitated by adding to it twice its volume of saturated brine, a mode of working sometimes adopted by soap analysts. It is hence evident that whilst the S.O.T. is often very convenient for testing highly-alkaline soaps commercially (the hydrolytic action of water on such soaps being a minimum), it is not of much value for discriminating the small amounts of free alkali which at most are permissible in high-class toilet soaps, inasmuch as the probable error of a test by this method will often (as with the F.A.T.T.) exceed the maximum amount of free alkali compatible with classification as a first-rate article; whence, finally it results that the "alcohol test" is the only one of real utility in such cases; independently of which, as above stated, it gives information as to the causticity or otherwise of the free alkali in a way impossible with the other two tests.

Nature of Soap used.	A.T.	S.O.T.	Excess of S.O.T. over A.T.
Pure Cocoa-nut Oil Soap, not strongly alkaline	5·0	9·1	4·1
Another sample of ditto	2·8	5·8	3·0
A British Toilet Soap, largely made from Cocoa-nut Oil	1·3	5·8	4·5
A foreign Toilet Soap, largely made from Cocoa-nut Oil (neutral)	0	3·5	3·5
A high-class American Toilet Soap..........................	1·8	5·4	3·6
A Toilet Soap largely made from lard (neutral)	0	3·2	3·2
A second-class ditto, chiefly made from tallow............	1·9	4·8	2·9
A Cotton-seed Oil Soap........	7·2	9·8	2·6
A Tallow-resin (primrose)	1·1	3·0	1·9
A Neutral Castor Oil Soap	0	1·7	1·7
A Bleached Palm Oil Soap	5·0	6·4	1·4
A tolerably Alkaline Curd Soap	18·3	18·3	0
Pure Stearic Acid Soda Soap (neutral)....................	0	0·7	0·7

IV.—*On two New Patents connected with Soap Manufacture.*

In connection with the above-described results, it may be of interest to refer briefly to two recent improvements introduced by one of us. One of these is mechanical rather than chemical, being primarily intended to diminish the large amount of waste unavoidably caused in the ordinary process of cutting up and shaping large rectangular blocks of soap for the formation of tablets, owing to the production of scrap; this is effected by forcing the hot fluid soap (by means of a pump, hydraulic ram, screw, or other convenient means) through a system of cooling tubes so arranged that the soap issues therefrom as a series of streams of soap just upon the solidifying point, but sufficiently soft and plastic to weld together completely on further passing into a moulding tube, from which a bar issues at the far end of dimensions regulated by a movable mouthpiece—the various tubes being jacketted, and so maintained at the particular temperatures requisite for the particular kind of soap operated upon.† In this way a considerable saving of time, labour, working space and material is effected as compared with the ordinary system, inasmuch as a continuous production of bar goes on as long as the supply of molten soap lasts.

The other is a purely chemical process, devised for the purpose of getting rid of the *bête noire* of the toilet-soap maker—viz., excess of alkali present in forms other than true soap, usually as carbonate or hydroxide. In the manufacture of Castile soap a small quantity of ferrous sulphate is often added to

* *First Grade.*—Soaps which are, if not actually neutral, at any rate so far devoid of free alkali that the amount of total alkaline matter present in forms other than actual soap does not exceed $\frac{1}{40}$th part (2·5 per 100) of the alkali present combined with fatty acids as soap.
Second Grade.—Soaps in which the free alkali, although exceeding $\frac{1}{40}$th part (2·5 per 100) of that combined as soap, does not overpass $\frac{3}{40}$th of that amount (7·5 per 100).
Third Grade.—Soaps in which the free alkali exceeds $\frac{3}{40}$th (7·5 per 100) of the alkali combined as true soap.
Journal Soc. Arts, xxxiii. 1124, Nov. 6, 1885.

† *Vide* Patent Specification No. 10,601, 1884.

the mass before cooling, for the purpose of producing the peculiar "mottle" of this class of soap;* the sulphuric acid of this salt converts a portion of the free alkali into sulphate, thereby diminishing the free alkalinity. It is obvious that this latter result would be equally brought about by using any other salt that would act on the alkali of the soap in the same way as ferrous sulphate; but inasmuch as a metallic oxide would also result, the use of such compounds is objectionable, because staining and discolouration of the mass would be apt to be brought about, as well as other inconveniences, owing to the presence of metallic compounds. By substituting an ammoniacal salt this difficulty is obviated†; the free alkali becomes a neutral salt corresponding with the ammoniacal compound employed, whilst the complementary product is ammonia (free, or as carbonate, in either case readily volatile) which escapes, part immediately, the remainder during the processes of cutting up and shaping, stamping, and exposure to air to dry and harden before boxing; even should a minute amount of ammonia be retained in the centre of the tablet, this is of no practical consequence, as the action of ammonia on the skin (as on woollen goods generally) is well known to be far less corrosive and injurious than that of an equivalent amount of fixed alkali, especially soda. This method of getting rid of free alkali is particularly applicable to "milled" soaps, inasmuch as the exposure to air in the form of thin ribbons, which necessarily takes place over and over again during the grinding together of the stock soaps and colouring matters, etc., ensures the complete volatilisation of the ammonia; so that only the faintest traces, or none at all, can be found in the finished tablets.

A working model of the machine described, and specimen bars made thereby (natural size), were exhibited; as also specimens of remelted and milled toilet soaps de-alkalised by the ammonia process, which was also illustrated in operation on the small scale.

DISCUSSION.

The Chairman, in opening the discussion, said the authors had referred to "mass action" as applied to the chemistry of soap; in his opinion many other departments of industrial chemistry involved this principle as well.

Mr. Lant Carpenter had been much struck by the authors' views upon "mass action." It might account to some extent for the differences observed by wool-scourers and other large users, in the behaviour of batches of soap precisely similar in composition so far as chemical analysis went.

Mr. Samuel Hall thought that more stress was often laid on the necessity for having no excess of alkali in soap than the question demanded.

Mr. Mactear could fully corroborate Mr. Lant Carpenter's remarks. He had found much difficulty in producing batches of soap of uniform strength, to suit makers of fine Scotch tweeds. Sometimes a soap completely destroyed the colour, though differing in constitution in no degree from a previous batch deemed quite satisfactory. He thought that the author's proposal to replace the free alkali by ammonia as likely to aid in securing uniformity in this direction. About ten years ago an apparatus for squirting soap had been brought before him by an American. But it differed in this respect from that exhibited—viz., in squirting the soap into a single large tube instead of into several small ones. The result was that it was almost impossible to cool the soap unless a very long tube was employed, or the action was stopped every now and then. The apparatus before the meeting seemed to have effectually surmounted this difficulty.

Dr. Alder Wright, in reply, said that he believed it was the practice for certain firms to remelt their soap with some palm oil or other easily saponifiable fat, in order to neutralise any excess of alkali. Many other methods for removing excess of alkali from soap had been proposed at various times, but all had more or less failed in certain cases. What Mr. Mactear had said in reference to the American squirting machine was quite new to him; he had been under the impression that his machine was the first of the kind. In reply to Mr. Hall, it is not the dissolving of soap in water which causes excess of alkali to be objectionable, but the rubbing of this irritant on the skin. It had been over and over again established that if more than two or three per cent. of the total alkali were present in the form of carbonate, this would be enough, if used day after day, to produce most uncomfortable irritation, especially on the tender skins of ladies and children.

* Many so-called mottled soaps of modern make are prepared in quite a different way; these substances differing from the old-fashioned mottles in being heavily watered, and consequently requiring a different mode of treatment to ensure the mottled appearance.

† *Vide* Patent Specification No. 14,681, 1884.

THE LIME PROCESS FOR THE PURIFICATION OF COAL GAS.

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Part I.

The impurities in coal gas, after passage through the scrubbers, containing sulphur as a constituent, are of three distinct kinds: (1.) Hydrogen sulphide. (2.) Substances yielding hydrogen sulphide when passed over heated surfaces, especially finely-divided platinum. These consist principally of carbon disulphide and traces of hydrogen thiocyanate, and probably carbon oxysulphide; the presence of the first having been further demonstrated by the production of its compound with triethyl phosphine (Hofmann), and its extraction from lime purifiers (Leicester Greville). (3.) Substances not convertible into hydrogen sulphide under these conditions, but burnt into sulphurous and thence to sulphuric acid, as estimated by the Metropolitan Gas Referees' sulphur test. These two latter kinds are generally classified as "sulpher compounds." The recent researches of Victor Meyer and his pupils on thiophen (C_4H_4S), which was first isolated from coal-tar benzene, and the relationship between this substance and pyrroline, seem to indicate that it, or its homologues, are amongst the sulphur compounds of the third class. The writer is now investigating this point. The principal purifying agents, adopted for the removal of members of the first two classes are ferric oxide and calcium hydrate, either in the damp state or in the form of milk of lime. The reactions taking place under various conditions between (1) calcium hydrate and hydrogen sulphide, (2) between calcium sulphide and carbon disulphide, under various conditions, and (3) the changes and decompositions induced by various substances likely to be present in coal gas issuing from the scrubbers, are the subjects of the present paper.

Reaction between Calcium Oxide and Hydrate with Hydrogen Sulphide.

The nature of the chemical changes between these substances has been the subject of investigation by

Berzelius* and Rose; † but more recently by Divers and Shimidzu,‡ Folkard,§ W. Foster, and the writer.||

Firstly, it has been observed that, at temperatures below 100° C., perfectly-dry hydrogen sulphide is not absorbed by perfectly-dry calcium oxide ¶—a phenomenon perfectly analogous to the non-absorption of dry carbonic anhydride by dry calcium oxide. The explanation in both cases is probably similar. Thus, n the latter case a small proportion of the calcium oxide dissolves in the trace of water. The solution absorbs the carbonic anhydride to form calcium carbonate, which is precipitated, and thus removed from the sphere of action; leaving the water to take up another small quantity of calcium hydrate, and so *ad infinitum*. In the former case, the calcium hydrate is dissolved as calcium hydrosulphide, $Ca(SH)_2$. This in its turn is decomposed into calcium hydroxy-hydrosulphide, Ca(SH)OH), which is precipitated; thus leaving the water to dissolve another portion of the calcium hydrate.

Secondly, if dry hydrogen sulphide is passed over calcium hydrate, calcium monosulphide and water are formed, in accordance with the equation—

$$Ca(OH)_2 + H_2S = CaS + 2H_2O,$$

a change effected readily and completely at temperatures ranging from 80° to 100° C., but more slowly at ordinary temperatures, owing to the formation of caked masses of the monosulphide, which enclose unaltered particles of the unchanged hydrate. As, however, there seems to be some doubt as to the completeness of the change at ordinary temperatures, the following experiment may be quoted on this point, with a sample of oxide, the preparation of which has been described at length in the author's paper in the *Journal of the Chemical Society.*

I.—*Hydration of the Oxide.*

3·0619grm. of calcium oxide gave 4·1142grm. of calcium hydrate.

	Found.	Theory.
Ratio of $\frac{Ca(OH)_2}{CaO}$ ..	1·323 ..	1·321

II.—*Synthesis of the Sulphide.—Temperature* 15° *C.*

Conditon of Experiment.	Weight of Calcium Compound, 4·000 Grammes.	Difference. Grammes.	Water Collected. Gramme.	Total Gain. Grammes.
After treatment with hydrogen sulphide for six hours, and hydrogen for two hours	5·5396 ..	1·5396 ..	0·0105 ..	1·5301
,, ,,	5·6528 ..	0·1132 ..	0·0151 ..	1·6784
,, ,,	5·6866 ..	0·0228 ..	0·0089 ..	1·7311
,, ,,	5·7011 ..	0.0448 ..	0·0212 ..	1·7701
,, ,,	5·7512 ..	0·0398 ..	0·0038 ..	1·8136
,, ,,	5·7474 ..	– ·0038 ..	0·0010 ..	1·8138
,, ,,	5·7326 ..	– ·0148 ..	0·0135 ..	1·8131

At this point the experiment was stopped, as the substance seemed to be only dehydrating slowly, as shown by the loss in weight of lime compound being equal to the gain in weight of the drying tube.

The total gain required by theory for the reaction—

$$Ca(OH)_2 + H_2S = CaSxH_2O + (2 - x)H_2O$$

is 1·837 grammes, of which 1·8131 grammes were found, or 98·74 per cent.

III.—*Analysis of the Resultant Substance.*

Gramme.		Gramme.	Percentage.		Mean.
0·3851	gave	0·514 $CaSO_4$	=39·22Ca	....	39·22
0·2240	,,	0·453 $BaSO_4$	=27·75	S	27·75
0·2008	,,	0·382 $BaSO_4$+0·003S	=27·75		
0·2166	,,	0·079 water	=32·03	H_2O	32·18
0·1866	,,	0·061	=32·34		
					99·15
		Oxygen, by difference		....	00·85
					100·00

Atomic ratio of calcium to sulphur = 1·13 : 1.

Comparing, then, the results of the analysis and the synthesis, 0·85 per cent. of oxygen is equivalent to 3·9 per cent. of calcium hydrate. Therefore, of the 4 grammes of calcium hydrate taken, 3·844 grammes only entered into the reaction.

Grammes.	Grammes.	Grammes.
3·844 $Ca(OH)_2$ should yield	3·753CaS+	1·902H_2O
0·156 $Ca(OH)_2$ are equal to	0·118CaO+	0·038H_2O
	3·871CaS+CaO	1·940H_2O
The 4·0 grammes of $Ca(OH)_2$ gave	3·831CaS+CaO	1·960H_2O

The error in both cases is slightly more than 1 per cent., probably accounted for by the difficulty of rigidly excluding all traces of air throughout an experiment lasting many hours, and the inevitable formation of small quantities of calcium thiosulphate. However, both the synthetical and analytical results are sufficient to show that 96 to 98 per cent. of the calcium hydrate is converted into the sulphide at ordinary temperatures. In the course of experiment, it was observed that the above reaction could be more rapidly effected in the presence of water in excess of that required for the production of the hydroxide—a result to be explained by the solution of the larger quantity of the hydroxide, and the greater readiness with which the hydrosulphide is temporarily produced.

The sulphur compounds of calcium have often been described as being of a blue or bluish-green colour; but this tint, which gave rise to the technical term "blue billy," is due to impurities of ferric oxide contained in the native lime. Pure calcium monosulphide is perfectly white; but rapidly turns a pale yellow on exposure to air, owing to the formation of calcium thiosulphate. The green-blue tint of the crude foul lime can be successfully imitated by slaking the pure specimens of the oxide with a solution containing 1 part of iron in 500,000 parts of water, and passing hydrogen sulphide over the product.

Thirdly, if hydrogen sulphide is passed into water in which calcium oxide is suspended, calcium hydrosulphide is formed, in accordance with the equation—

$$Ca(OH)_2xAq + 2H_2S = Ca(SH)_2 + 2H_2OxAq.$$

This substance eventually crystallises out in white acicular needles. This change is the more perfect the lower the temperature at which it is effected; in fact, a freezing mixture is required for the crystallisation of the hydrosulphide. But, in any case, the hydrogen sulphide in excess of that required for the monosulphide is readily evolved by passing into the solution an inert gas, such as hydrogen or nitrogen, or even by mere exposure to the air.** Under any of these conditions, the sparingly-soluble hydrated calcium sulphide or calcium hydroxy-hydrosulphide is precipitated in accordance with the reaction—

$$Ca(SH)_2 + OH_2 = CaSH,OH + H_2S,$$

a change accompanied by the evolution of heat, for, according to Thomsen,†† the substitution of an atom of sulphur by an atom of oxygen in the case of compounds of alkalis and alkaline earths corresponds to a heat evolution of 51·3 heat units.

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* Schweigger's Journal. xxxiv. p. 12. † *Ibid.* lv. p. 443.
‡ Jour. Chem. Soc. 1884, p. 278.
§ Chemical News, xlix. p. 258.
|| Jour. Chem. Soc. 1885, p. 478.
¶ A precisely-similar phenomenon was observed by Thorpe in the course of the conversion of titanium oxide into the sesquisulphide. (See Jour. Chem. Soc. 1885, p. 491.)

** Divers, *cf. supra.* †† Jour. fur Chem. [2], 191, 21.

Reaction between Calcium Sulphide or Hydrate and Carbon Disulphide.

Nearly fifty years ago, Berzelius* described the preparation of calcium sulphocarbonate or thiocarbonate by digesting together calcium sulphide, carbon disulphide, and water; but no analyses were given of the resultant substance. More recently D. Walker† prepared a basic calcium thiocarbonate—

$$CaCS_3 2Ca(OH)_2,8H_2O$$

by agitating milk of lime with carbon disulphide—a reaction effected, according to Sestini,‡ by exposure of such a mixture to sunlight. According to Sestini's description, it would appear highly probable that there can be formed a series of such combinations of the hydroxide and thiocarbonate, varying in colour from a pale yellow to a deep red, according to the proportion of carbon disulphide contained therein. Sestini, Gauvy, and Rotondi proposed to decompose such a liquid by potassium carbonate as a cheap method for the preparation of a solution of potassium thiocarbonate, an antidote to the *phylloxera*; but, according to the experiments of Rotondi, § a solution of calcium thiocarbonate could not be obtained containing more than 5 per cent. combined carbon disulphide.

Now, it has been observed, both on the manufacturing and on the small scale, that perfectly-dry calcium sulphide does not absorb carbon disulphide. In the course of the writer's experiments, this point has been determined, first, by passing hydrogen, mixed with the vapour of carbon disulphide, over a weighed quantity of pure dry calcium sulphide; no gain in weight was observed, nor alteration in colour, nor diminution of proportion of carbon disulphide present in the gas as indicated by Mr. Vernon Harcourt's colour test. Secondly, some calcium hydrate was slaked, and moistened so as to form a material of consistency similar to that used in gas-works. *Dry* sulphuretted hydrogen then passed in to convert it into sulphide, and determinations were made of the amount of carbon disulphide absorbed (the relation between the volume of the gas and the volume of the purifying material being the same as that in practice) when dry hydrogen mixed with the vapour of carbon disulphide was passed into it. But this sulphide, instead of absorbing all the carbon disulphide present in the gas, absorbed only 60 per cent., and after a time became inactive; but its activity was restored, and increased to its full value, by merely damping it. This result, on the small scale, is precisely analogous to that obtained on the large scale when the lime purifiers are said to "work dry." On moistening the calcium sulphide with a large quantity of water, and passing carbon disulphide into it, it turns rapidly from a white to an orange yellow, and thence to a red colour; a red liquid ultimately draining down from the sulphide. On evaporation of the liquid, a basic calcium thiocarbonate—$Ca(OH)_2CaCS_3 7H_2O$—separates out. But the nature of the reaction between the calcium sulphides and carbon disulphide can best be studied by passing the vapour of the latter substance into a solution of calcium hydrosulphide. At first hydrogen sulphide is given off in large quantities, with precipitation of the calcium hydroxy-hydrosulphide. When this is completed, the absorption of carbon disulphide commences, as evidenced by the liquid becoming nearly solid by the formation of yellow crystals of another basic calcium thiocarbonate—probably—

$$2Ca(OH)_2CaCS_3,10H2O.$$

* Pogg. Ann. vi. p. 444.
† Chemical News, xxx. p. 28.
‡ Gazzetta, i. p. 473; xii. p. 477.
§ Le Stazioni sperimentali Agrarie (Firenze), 1880, p. 104.

These in their turn dissolve, to form the above-mentioned red liquid. It results from these observations that neither dry calcium sulphide nor calcium hydrosulphide is an active material for removing carbon disulphide, but calcium hydroxy-hydrosulphide. The absorption of the carbon disulphide is dependent upon the solution in small quantities of the hydroxy-hydrosulphide, the combination of the dissolved portions with carbon disulphide to form a thiocarbonate whose solubility increases with the proportion of carbon disulphide taken up. But whatever the method of conducting this change, the evolution of hydrogen sulphide is concomitant with the absorption of the carbon disulphide, and the reaction expressing these changes can be written probably thus—

1. $2CaSHOH + CS_2 = Ca(OH)_2,CaCS_3 + H_2S.$
2. $3CaSHOH + CS_2 + OH_2 = 2Ca(OH)_2CaCS_3 + 2H_2S.$

This evolution of hydrogen sulphide was rendered evident, in the usual way, by lead acetate paper. These results are in perfect accordance with the experience of gas engineers, who have noticed that the material from the lime boxes worked according to Mr. H. E. Jones's process (described in his paper read before the Institution of Civil Engineers‖) differs entirely from ordinary spent foul lime in emitting a faint odour of carbon disulphide, but no quantity of hydrogen sulphide, and in being slowly oxidisable.¶ The above experiments explain the reason of the inactivity of a lime purifier, when it has become "over-fouled," or fouled at a low temperature,** for the active calcium hydroxy-hydrosulphide has become converted by the excess of hydrogen sulphide into the inactive hydrosulphide. To restore its activity, either air is blown into the purifiers, or the foul lime is taken out, broken up, and returned to the box; the exposure causing it to steam and emit a considerable quantity of hydrogen sulphide. The colour also changes from a white to a dark green; owing, in some way or another, to the conditions being favourable to the formation of the ferrous sulphide. In the former of these cases the blast of air removes the excess of hydrogen sulphide, and causes the production of the active hydroxy-hydrosulphide; while in the latter this change is effected both by the mechanical process of breaking up, and thus exposing unaltered lumps of the hydrate to the action of the emitted hydrogen sulphide, and by the chemical reaction induced by exposure to the air.

Part II.

In order to arrive at an experimental demonstration of the various phenomena experienced by gas engineers in the course of the purification of coal gas from carbon disulphide, experiments were conducted in miniature, but to scale, as regards the relations between the rate of passage of the gas to be purified to the volume of the purifying material. The plan adopted was an imitation of the system of purfication in use at the Commercial Gas-works, under Mr. H. E. Jones, which was described at length in his communication to the Institution of Civil Engineers already referred to. Instead of coal gas freed from hydrogen sulphide and carbonic anhydride, there was substituted hydrogen containing a quantity of sulphur, in the form of vapour of carbon disulphide, varying from 10 to 60 grains per 100 cubic feet; the average quantity of "sulphur," as organic sulphur compounds, in coal gas, after leaving the scrubbers,

‖ Proc. Inst. C.E. lxi. Part ii.
¶ Leicester Greville, *vide* Journal of Gas Lighting, 1883, p. 1504.
** This was particularly observed by Mr. H. E. Jones, engineer of the Commercial Gas Company, at their Wapping works, in the winter of 1879-80.

being 30 to 40 grains. According to calculations of Mr. Vernon Harcourt, from results communicated to him by several of the managers of London Gas-works, for every 1000 cubic feet of gas to be purified per hour, 20·3 to 110 cubic feet of lime are used. These figures were taken as the basis of calculation; and on a glass tower was measured off a volume of 0·01 cubic foot. This was filled with pure calcium hydrate of such consistency that it could be slightly moulded with the fingers. The rate of the gas to be purified was varied, according to the condition of the experiment, from 0·5 to 0·091 cubic foot per hour; the maximum rate corresponding to the minimum quantity of lime used per 1000 cubic feet per hour, and conversely.

The experimental plant was arranged as follows:—First, a Kipp's apparatus for the constant generation of hydrogen, which was freed from any spray of sulphuric acid by passing through bulbs containing water. The gas then flowed over a bulb-shaped tube filled with carbon disulphide; the neck of the tube being drawn out, and provided with a small pin-hole for the vaporisation of the liquid. The gas could then pass in one of two directions—viz., either directly into a glass tower filled with ferric oxide, or through the lime purifier, and thence through the ferric oxide. The object of the oxide was to absorb the hydrogen sulphide either as formed in small quantities by the action of the dilute sulphuric acid on commercial zinc, or as emitted from the purifier. The gas then passed into the colour-test apparatus of Mr. Vernon Harcourt.

Preliminary experiments were made to determine (1) whether the proportion of carbon disulphide vaporised by the hydrogen remained constant, under constant conditions of temperature, within the limits of time in which testings were made; and (2) to ascertain whether the proportion of sulphur indicated by the colour tests varied with the rate at which the gas was drawn through the test apparatus by the aspirator—the rate of passage of gas being estimated by the time occupied by the testing and the volume of water which had run out into the measuring cylinder. The results were found to be satisfactory. Before each set of experiments, blank testings were made; the bulb containing the carbon disulphide being temporarily removed, to ensure that the gas was free from all sulphur compounds. All the testings were conducted in duplicate. In the earlier experiments one-third of the calcium hydrate was converted into the sulphide. The material thus obtained was of a pale yellow colour, due to a slight oxidation. But as this gave unsatisfactory results as regards the removal of the carbon disulphide, another third was converted into sulphide, and the results were satisfactory. The following may be cited:—

Series I.—*Rate of Gas (approximately), 5 Cubic Feet per Hour.*

Composition of Gas.	Grains of Sulphur. per 100 Cub. Ft.	Percentage of Sulphur removed.
(1) Sulphur as carbon disulphide present in gas	62	—
(2) After passage through calcium sulphide	4·4	94.5

Series II.—*(Conditions as above.)*

(1) Sulphur as carbon disulphide	56	—
(2) After passage through calcium sulphide	nil	100

Series III.—*(Conditions as above.)*

(1) Sulphur as carbon disulphide	21·7	—
(2) After passage through calcium sulphide	nil	100

Series IV.—*Rate of Gas 0·67 Cubic Foot per Hour.*

(1) Sulphur as carbon disulphide present in gas	80	—
(2) After passing through calcium sulphide	8·1	89·8

These results show that damp calcium sulphide is a fairly-efficient material for removing carbon disulphide. Similar series of experiments were conducted with a sample which had been "sulphided" by dry hydrogen sulphide (*vide supra*); but this absorbed not more than 66 per cent. of the carbon disulphide.

Series V.—*Rate of Gas, 0·5 Cubic Foot per Hour.*

Composition of Gas.	Grains of Sulphur per 100 Cub. Ft.	Percentage of Carbon Disulphide removed.
(1) Sulphur as carbon disulphide present in gas	25·7	—
(2) After passing through calcium sulphide	8·6	66·1

Series VI.—*(Conditions as above.)*

(1) Sulphur as carbon disulphide	35·7	—
(2) After passing through sulphide	11·1	61·0

Series VII.—*(Conditions as above.)*

(1) Sulphur as carbon disulphide	26·3	—
(2) After passing through sulphide	9·4	61·0

Effect of Temperature.

In order to study the effect of temperature, the cylinder containing the sulphide was surrounded by a freezing mixture of ice and salt; and the activity of the material was decreased, as shown by the following results:—

Series VIII.—*(At* 15° C.)

Composition of Gas.	Grains of Sulphur per 100 Cub. Ft.	Percentage of Carbon Disulphide removed.
(1) Sulphur as carbon disulphide	20·8	—
(2) After passing through sulphide	7·2	71·4

Series IX.—*(At* – 10° C.)

(1) Sulphur as carbon disulphide	16·1	—
(2) After passing through sulphide	8·5	50·0

This result explains in a further way the inactivity of purifiers in very cold weather. In this, as in all other observed cases, the rate of chemical change decreases with decrease of temperature.

But in all these cases the yellow colour gradually mounted up the cylinder; thus indicating the evolution of hydrogen sulphide, noticed in Part I.

Effect of Various Gases.

A series of experiments was made with the view of investigating the chemical changes induced by the passage of gases likely to be present in coal gas issuing from the scrubbers, on a sample of foul lime which had absorbed a considerable quantity of carbon disulphide, and assumed a uniform orange-red tint, characteristic of the basic calcium thiocarbonate.

Series X.—*Hydrogen.*

Rate of Passage of Gas (approximately), 0·5 *Cubic Foot per Hour. Temperature,* 15° C.

(1) Hydrogen passing through ferric oxide, and thence over platinised pumice	The lead syrup remained unaltered.
(2) Hydrogen passing through the thiocarbonate, and thence over platinised pumice	"

The calcium thiocarbonate is not decomposed by hydrogen at ordinary temperatures. Similar results were obtained with purified marsh gas.

Hydrogen Sulphide.—To study the effect of hydrogen sulphide, a Wolff's bottle with three tubulures was introduced into the apparatus, immediately after the washing-bulbs. This contained a dilute solution of hydrogen sulphide, the strength of which could be renewed from time to time by passing a few bubbles of the gas by means of the middle tubulure from a Kipp's apparatus. The hydrogen blowing over the

surface of the solution carried forward a small quantity of the gas, which was passed immediately into the colour-test, and estimated in the usual way. The experiment was repeated, the hydrogen sulphide being absorbed by the ferric oxide purifier.

SERIES XI.—*Hydrogen Sulphide.*

Rate of Passage of Gas (approximately), 0·5 Cubic Foot per Hour. Temperature, 15° C.

Conditions.	Grains of Sulphur per 100 Cub. Ft.
(1) Sulphur present as hydrogen sulphide; the platinised pumice being cold	100
(2) Do. after passage through the "sulphided" lime and ferric oxide	Nil
(3) Same as (2): the platinised pumice being heated	10·2

From the above experiment it is seen that, whereas all the sulphur as hydrogen sulphide is removed by the sulphide of lime and ferric oxide, there is driven forward a small quantity of carbon disulphide, as indicated by its conversion into hydrogen sulphide on warming the bulb of the colour-test. The result is due probably to a local formation of calcium hydrosulphide and the decomposition of the thiocarbonate. It is in perfect accordance with the observations of gas engineers, who have noticed that, as the quantity of hydrogen sulphide passing into the calcium sulphide purifiers was greater or less, the efficiency of the purifiers was inversely diminished or increased. *

To add confirmatory evidence, a series of experiments was conducted in succession. It was ascertained once for all that no carbon disulphide was present in the apparatus, and that all the hydrogen sulphide contained in the gas was perfectly absorbed by the sulphided lime and ferric oxide.

SERIES XII.

	Grains of Sulphur as Hydrogen Sulphide per 100 Cub. Ft.			Grains of Sulphur as Carbon Disulphide per 100 Cub. Ft., evolved by the Decomposition of the Thiocarbonate.
(1)	167	....	(1*a*)	33·3
(2)	77	....	(2*a*)	22·7
(3)	89	....	(3*a*)	23·8
(4)	79	. ...	(4*a*)	21·1

From these experiments it follows that the greater the quantity of sulphuretted hydrogen passing into the purifier, the greater the quantity of carbon disulphide eliminated. In fact, these results are precisely analogous to the well-known "gushes or discharges of sulphur" when the purifiers are worked on the Paterson or continuous system.

Effect of Carbonic Anhydride.

It has long been known that before the coal gas passes into the vessels, used for the removal of carbon disulphide, all the carbonic anhydride must be removed, inasmuch as this substance decomposes both calcium sulphide and thiocarbonate, with elimination of hydrogen sulphide and carbon disulphide respectively.† In order to ascertain the magnitude of these decompositions, under conditions likely to occur, the effect of hydrogen containing a quantity of carbonic anhydride equal to that present in coal gas issuing from the scrubbers (500 to 1100 grains per 100 cubic feet) was studied. The artificial gas was prepared by passing into a gasholder filled with hydrogen a few bubbles of carbonic anhydride, the proportion of which was determined by Pettenkoffer's well-known baryta-water method. The mixture, after passing through the washing bulb, entered the calcium sulphide purifier, and thence either directly into the colour test, or through the ferric oxide purifier, and then to the colour test. If the platinised pumice be heated, and the gas passed through the ferric oxide, the amount of carbon disulphide eliminated is determined; but if the gas is not passed through the ferric oxide the amounts of hydrogen sulphide and carbon disulphide together are estimated. The difference between the former and the latter value gives the quantity of hydrogen sulphide. Two conditions are likely to occur in practice. In the one the foul lime purifier may contain unaltered calcium hydrate; in the other, the lime may be completely fouled. The effect of the carbonic anhydride under each of these conditions was observed. The results showed that in the former case carbon disulphide only is eliminated; the unaltered portions of the calcium hydrate absorbing all the hydrogen sulphide, and simultaneously a portion of the carbon disulphide.

* H. E. Jones, *loc. cit.*
† King's "Treatise on Coal Gas," vol. ii. Part iv. p. 22.

SERIES XIII.

Lime Purifier containing Three Parts of Sulphide and Thio-carbonate, and One Part of Unaltered Calcium Hydrate. Rate of Gas (approximately), 0·5 Cubic Foot per hour; Temperature, 15° C.

Grains of carbonic anhydride per 100 cubic feet, 1126.

Conditions.	Grains of Sulphur as Carbon Disulphide per 100 Cubic Feet.
(1) Gas passing through sulphided lime and ferric oxide	3·15
(2) Gas passing through sulphided lime only	3·78

SERIES XIV.—(*Conditions as above.*)

Grains of carbonic anhydride per 100 cubic feet, 1183.

	Grains of Sulphur as Carbon Disulphide.
(1) Gas passing through sulphided lime and ferric oxide.........	2·3
(2) Gas passing through sulphided lime only	2·2

The remaining one-fourth of the calcium hydrate was then converted into sulphide by hydrogen sulphide, the excess of which was blown out by a current of hydrogen before testings were made.

SERIES XV.—(*Conditions as above.*)

Grains of carbonic anhydride per 100 cubic feet = 351.

	Grains per 100 Cubic Feet.
(1) Sulphur as carbon disulphide and hydrogen sulphide liberated............	22·7
(2) Sulphur as carbon disulphide..........	3·0
Difference = hydrogen sulphide ..	19·7

SERIES XVI.—(*Conditions as above.*)

Grains of carbonic anhydride per 100 cubic feet = 417.

(1) Sulphur as carbon disulphide and hydrogen sulphide liberated............	27·0
(2) Sulphur as carbon disulphide..........	3·9
Difference = hydrogen sulphide ..	23·1

SERIES XVII.

Grains of carbonic anhydride per 100 cubic feet = 780

(1) Sulphur as carbon disulphide and hydrogen sulphide liberated	31·7
(2) Sulphur as carbon disulphide	6·0
Difference = hydrogen sulphide ..	25·7

Then, under these conditions, not only is hydrogen sulphide emitted, but the proportion of carbon disulphide emitted is increased.

In conclusion the author wishes to record his best thanks to Mr. Vernon Harcourt for kind assistance and advice. He is also greatly indebted to Mr. Jones's paper for the suggestion of some of the experiments above detailed.

[The author illustrated, by experiments, the actual method employed for obtaining the results described in Part II. of the paper.]

DISCUSSION.

The CHAIRMAN (Mr. D. Howard) said Mr. Veley's communication was a very interesting one; and the subject of gas purification was one with which the members were all in some way concerned. There were few points more important than the total removal of carbon bisulphide from gas; and he was old enough to remember when it was regarded as almost a hopeless task. The singularly-easy method whereby it was at present removed, the chemistry of which had been so ably explained, was one of those happy adaptations of a very simple process which was really amongst the most valuable discoveries in chemistry.

Professor FOSTER said there was one point in connection with this question, of the action of sulphuretted hydrogen on lime, which he did not think had yet been quite cleared up. Dr. Divers, in his admirable paper, gave a considerable amount of information with reference to the hydrosulphide and the hydroxy-hydrosulphide described by Mr. Veley.* At the time he took occasion to note that if, by his statement, Dr. Divers meant that the treatment of calcium hydrate with sulphuretted hydrogen was attended with the production of hydrosulphide only, under the conditions which obtained in the ordinary lime purifier of the gas engineer, he could not agree with him. Like most men engaged in matters relating to coal gas, he had worked on this lime question; but all alike seemed to be in the dark until Dr. Divers's paper appeared. The subject of his own inquiry had then resolved itself into the action of sulphuretted hydrogen on pure lime, although he began with a large number of specimens of spent lime; the results being very similar to those of his predecessors—viz., entirely unsatisfactory. Dealing with commercial lime, he endeavoured to get at some knowledge of what happened when sulphuretted hydrogen was passed into it, commencing at the ordinary temperature, and keeping well within the temperatures which were produced by the chemical action of the sulphuretted hydrogen on the calcium hydrate. The result of his inquiry was to lead to the following conclusion:—That if calcium hydrate was treated with sulphuretted hydrogen in this way, under the ordinary conditions, this result (expressed empirically) was obtained—$CaOCaS2H_2O$. Expressed constitutionally (following Dr. Divers), the formula was—Ca2HOCaHOHS. The point was this—that such a compound only contained one-half the sulphur which Dr. Divers and Mr. Veley attributed to the compound in question. Dr. Divers stated in his paper that calcium hydrosulphide was produced in the lime purifiers. It might be that some of the conditions could be explained, because they all knew, from the experience of Dr. Divers and Mr. Veley, that hydrosulphide underwent splitting up into calcium hydroxy-hydrosulphide, with a production of calcium hydrate. What he wished to point out was (and it was a practical matter for gas managers) that, in the purifiers charged with calcium hydrate, the condition of things named would result. Speaking from memory, the compound contained 20 per cent. of sulphur. Another practical point was this: He had never met with a specimen of spent lime obtained in the ordinary way, and containing moisture, in a condition which had more than 10 per cent. of sulphur. Therefore, if a gas engineer followed the formula as he had given it—and he believed it to be quite possible—if he tried to realise this condition of things, he would never ordinarily reach more than 20 per cent.; and however long he tried he would never succeed in getting much beyond this. The action was a perfectly definite one. If a tube containing calcium hydrate were taken, and if sulphuretted hydrogen were then passed—a dryer and an absorber of oxygen being arranged intermediately—the action was quite progressive. Hour after hour the progression of the sulphuretted hydrogen could be seen, and as long as there was a particle of lime in front no sulphuretted hydrogen passed through the tube. Sulphuretted hydrogen might even be passed through for some time, and after it escaped freely, if the compound were then removed and dried over sulphuric acid such figures as these would eventually be found—$CaOCaS2H_2O$. He believed that Dr. Divers's statement and his own experience might be reconciled. All he contended was that, in the lime purifier, as ordinarily charged, the formula which he had given was nearly the actual condition of things that would obtain under such circumstances. If, therefore, one used the constitutional formula—showing a so-called molecular compound—they could understand how the action on bisulphide of carbon took place. In relation to the paper, many other questions arose which he would have liked to go into; but, after all, this was the practical point—that one could not get anything like the percentage of sulphur into the calcium hydrate which the able experiments of Dr. Divers had incidentally led people to believe. It might possibly be done at a very low temperature, but unless the gas engineer realised such conditions he would fail in his task. From a money point of view, it meant, of course, that if calcium hydrate were used for the purpose of taking out sulphur, there again arose the question of expense in effecting the object, because he could in this way never get more than such a ratio, unless he passed sulphuretted hydrogen for a very prolonged time. He had specimens of lime obtained by passing sulphuretted hydrogen, taking out the mixture and allowing it to be again treated; but he never obtained, under these conditions, with ordinary dry hydrate, 1 atom of calcium to 1 of sulphur.

Mr. C. W. FOLKARD said it had been remarked by the last speaker that, in the ordinary process of purification in gas-works, it was impossible to get more than about 50 per cent. of the lime transformed into sulphide. Two years ago he published in the *Chemical News*, the results of some experiments he had conducted on a small scale, which showed very plainly that this was the case; and he frequently analysed the material coming from the lime purifiers, and had never been able to get more than 51 per cent. transformed—it varied from about 42 to 51 per cent.—even after the gas containing sulphuretted hydrogen had been passed until a large quantity had come right through the purifier for several days. He thought it exceedingly probable that this was due to a matter which had been referred to earlier in the evening—viz., to the action of mass—because the crude gas contained an exceedingly small proportion of sulphuretted hydrogen. He could understand that, if pure sulphuretted hydrogen were passed into slaked lime, it was quite possible that the reaction would be such as to transform the whole of the lime into calcium sulphide, instead of getting a molecule of calcium sulphide to combine with one of unaltered lime, which was undoubtedly the form in which the reaction took place in ordinary gas-works. He would ask Mr. Veley to tell them exactly how he prepared the sample of slaked lime. He had been careful to proportion the amount of gas passing through to the bulk of material. But there was another small point which made a great deal of difference in these matters, and it was this—that the depth of material was not the same. In an ordinary purifier the material would be something like 24 inches deep, and

* See Journal of Gas Lighting, Sept. 9, 1884 p. 471.

therefore the gas would pass very much more rapidly past a given particle of lime. Mr. Veley had properly proportioned the cubic amount of purifying material to the volume of gas, but had not the same surface area as existed in gas-works. He (Mr. Folkard) should think that it would be about one-eighth or one-tenth, and this would make a vast difference in the result. It was well known that if the purifiers were three or four times the usual area, the purifying action was much greater, whereas Mr. Veley's experimental purifier had about one-tenth the area usual in gas-works. It had been found, in experimenting on a small scale, that almost anything would take out carbon disulphide, therefore these small experiments were always liable to lead to error.

Dr. P. F. Frankland asked Mr. Veley whether he had the proportionate amount of sulphur compounds in the gas as well as the total quantity of gas. If this were a question of mass action, as Mr Folkard suggested, it was, he said, obvious that very different results would be obtained according as a larger or a smaller proportion of sulphide of carbon was used respectively to a smaller or larger proportion of gas.

Mr. Veley, in reply, said he had conducted the experiments in this way: Starting with a known quantity of lime, he passed the sulphuretted hydrogen into it, and weighed the material, and also the water which was formed. Making a synthesis of the product, he had shown that, starting with a known weight of lime, and passing in sulphuretted hydrogen until all the change was complete, as shown by the fact that the continuation of the passage of the gas merely caused a dehydration of the material (that was to say, the loss of the tube containing the lime was exactly equal to the gain found in the water collected) the result was—

$$Ca(OH)_2 + H_2S = CaSH_xO + (2-x)H_2O.$$

Making analyses of this material, he found the result coincided almost exactly with that of his synthesis. Even according to Professor Foster's own admission, substances examined by him were really admixtures of calcium sulphide and unaltered lime; for he himself said that if he took out the lime, shook it about and otherwise disturbed it, put it back again, and then repeated the action with sulphuretted hydrogen, he could get a larger quantity of the gas absorbed.

Professor Foster said this was scarcely so. What he wanted to point out was that, when sulphuretted hydrogen was passed into slaked lime at the ordinary temperature of a room, the affinity or attraction was most marked, and the sulphuretted hydrogen progressed most slowly, so that not a particle of lime escaped its action; then the action stopped, and the sulphuretted hydrogen passed most freely. If the lime were taken out and rubbed up, and then had a dose of sulphuretted hydrogen given to it, the percentage might be slightly increased. Whether the increase in the action of the lime was due to oxidation, to the rubbing up, or to the hydrolysis through the presence of moisture, he could not say; but the action, in the first instance, was a definite one, and seemed to stop at a certain stage.

Mr. Veley said he had never arrived at this stage, but always found it go on to a further one. If the experiment at this stage were carried on at the ordinary temperature for many days, then the result was complete. He took it that Professor Foster's results were due to what he (Mr. Veley) had always found an exceedingly practical difficulty—damp calcium sulphide caking round, and thus enclosing nuclei of unaltered lime. It was obvious that if a certain amount of calcium sulphide caked together, as it would, there would be also included in such a caked mass quantities of unaltered lime. The great practical difficulty in working was to avoid this caking together of material. Mr. Folkard had inquired how he prepared his slaked lime. For these experiments he started with a known quantity of purified calcium oxide, from which all impurities (such as iron, silica, barium, and strontium) were removed. He hydrated it in an apparatus devised to eliminate all traces of carbon anhydride, and then succeeded in converting a certain weight of calcium oxide into the theoretical quantity of calcium hydrate (the figures were given in the paper). This material was put into a tube, and perfectly dry sulphuretted hydrogen, from which all traces of oxygen had been carefully removed, sent in. It did not follow that, when some sulphuretted hydrogen passed over, the reaction was therefore complete; in fact, the reaction would go on slightly even, for a long time after volumes of sulphuretted hydrogen passed through the lime purifier, owing, as he took it, to the caking together of these damp masses of calcium sulphide. For these experiments pure lime was mixed with water so as to form a substance of similar consistency to that used by gas engineers. He had made many experiments, varying the rate and the proportion of carbon disulphide, and under these conditions all the carbon disulphide had been removed. If, then, it was all removed, taking the minimum volume of lime with the maximum quantity of gas containing the largest quantity of carbon disulphide likely to be present in practice—*a fortiori* this would be removed when a lower rate was taken, and when the gas contained a smaller proportion of carbon disulphide. He could not agreed with the suggestion of Mr. Folkard that it was proper to take the relation of the area of the purifying material to the volume of gas to be purified. It appeared to him that in this case two different kinds of quantities were being dealt with—square feet of purifying material and cubic feet of gas to be purified, and this seemed to be rather au irrational way of looking at it. They must be put in the same terms—viz., volume of purifying material to volume of gas; for, even although the gas to be purified passed over, it also passed through the cubic contents of the purifier. Thus he thought the proper relation to be taken was that of volume to volume. When such a purifier had been in action for some time all the sulphuretted hydrogen was gradually driven off, and the lime from this purifier merely possessed the odour of carbon disulphide, not the peculiar disagreeable odour of ordinary foul lime.

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THE COMPARATIVE EFFICIENCY OF VARIOUS MODES OF TREATING LIQUIDS WITH GASES.

F. HURTER, PH.D.

When our engineers are asked to erect any structure, they calculate the probable weight which it has to

carry, or the stresses it is subject to: they take out of their pocket a valuable thing called a "Molesworth," or some other book filled with formulæ, and by means of them calculate the dimensions of their structure. Their skill and experience is employed in choosing and combining the materials and the factors of safety, and they trust the rest to Molesworth and providence. I am told that most of the structures of the chemical works in Widnes are based upon these formulæ collected in Molesworth. Why can we trust so implicitly to such formulæ? Simply because they are the most concise record of the experiences of our most eminent engineers; and not only a record of their experience, but also of their success in tracing out the causes of the phenomena they have observed.

In the construction of chemical apparatus, as far as the strength is concerned, the same facility is afforded; but as regards every other particular we are left entirely to our fancy, or in the case of long experience, to that second sight which is gradually and unconsciously acquired. But with the termination of the career of many a successful man terminates also his whole experience. Owing to the fact that his experience was not in a form sufficiently concise to be readily transmitted to others, that it was not formulated experience—it is entirely lost. I have frequently felt the want of such guides to the best form and general construction of new apparatus, as the engineers possess for finding the dimensions, when the general form is given to them. I have consequently always been anxious to collect isolated experiments under a general formula. I have tried to collect the whole of the experience of myself and others of vitriol chambers in such a single formula, and I brought the results of such an attempt before this Society some years ago.

To-night I wish to discuss the comparative efficiency of various modes of treating liquids with gases. I meant to discuss all the modes now in use, but I found the subject too large for one paper. I have decided, therefore, to discuss only one class of apparatus, but so that the paper will form an independent whole, and I may, at some future meeting, if it be your pleasure, discuss the remainder of the subject.

I.

The treatment of a liquid with a gas has usually one or both of two ends in view: either we wish to saturate completely a liquid with one of the constituents of a gaseous mixture, or we want to deprive the gas wholly of one of its components, or we are obliged to accomplish both the saturation of the liquid and the complete absorption of one of the gaseous substances constituting the mixture. Sometimes a liquid is treated with a gas for the purpose of removing from the liquid a volatile compound.

For whichever of these purposes we treat a liquid with a gas, the mechanical part of the problem is always the same: we must bring the gas into intimate contact with the liquid. This intimate contact can only be brought about by the expenditure of energy; we have to do a certain amount of mechanical work. But the problem of treating liquids with gases is not so simple as to resolve itself merely into a discussion of how to produce the intimate contact with the least expenditure of work; we might produce a very intimate contact very cheaply, but afterwards waste the contact by otherwise badly arranging our apparatus—*i.e.*, obtain a very small effect in spite of the intimate contact—if we paid not sufficient attention to the chemical part of the problem.

Before we can speak either of the mechanical efficiency of a piece of apparatus producing the necessary contact, or of the efficient utilisation of the contact so produced, we must have some measure for the contact itself—we must have a unit of contact. The amount of absorption which will take place between a gas and a liquid will depend entirely upon the number of molecules of the gas which will, during a given time, impinge upon the liquid—*i.e.*, it will be proportional to the extent of the border-surface between the liquid and the gas, to the number of molecules which impinge upon the unit area of this surface in unit of time, and to the length of time during which these conditions obtain. As the number of molecules which impinge upon unit-surface in unit of time is proportional to the pressure of the gas, the pressure itself may be substituted for that unknowable number. I shall, therefore, define (for the purposes of my comparison of the efficiency of various apparatus) one unit of contact to mean that unknown number of molecules which would impinge upon unit area in unit of time if the gas exerted unit pressure.

For technical reasons I choose the following units:—As unit area, the square meter; as unit pressure, 1 meter of water; as unit time, 1 second. So that 1 unit of contact means the number of molecules of a gas which would impinge in one second upon 1 square meter area if the gas were under a pressure of one meter of water.

Five units of contact might be obtained from three different sets of conditions; we might have five square meters' area acting during one second with the gas of one meter pressure, or we might refer to one square meter acting for five seconds with a gas of one meter pressure, or we might refer to a surface of one square meter maintained for one second, the gas being under a pressure of five meters of water. In each of these cases the actual number of molecules impinging would be exactly the same, and, consequently, if in all three cases the chemical condition of the liquid and the gas were the same, the rate of absorption would also be the same.

The mechanical efficiency of any piece of apparatus can thus be measured by the number of such units of contact which it yields for a given expenditure of work, say for the expenditure of one kilogrammeter.

All apparatus for bringing into contact liquids and gases can be divided into three classes, according to the method employed for producing the contact-surface.

(1.) The gas, divided into small bubbles, passes through a column of liquid.

(2.) The liquid, divided into fine drops, falls through a column of gas.

(3.) Solids, with extensive surfaces and interstices, are covered with the liquid, the gas filling up the interstices.

A comparison of the efficiency of these various classes of apparatus is very difficult, and I have not completely solved the problem; but what I have done will, I hope, form a foundation for other investigators, and form, to some extent, a guide to the choice of apparatus for any given case.

That such a choice is sometimes extremely difficult, is illustrated by the various apparatus which various technologists prefer for one and the same process. Thus, for instance, I found when I came to this country, just at the time when Mr. Weldon's process for the recovery of manganese was about to be introduced, one chemist attempting to subdivide the liquor in which the manganous oxide was suspended into fine spray, and allow it to fall through air. In a patent (not Mr. Weldon's) I found a proposal to project that liquid into the air by means of paddle-wheels. Then we have Mr. Weldon's own solution of the problem—the best—which consists, as you are well aware, in injecting the air into the liquid.

I shall confine my remarks to-night to apparatus of the first class—that where the gas is divided into fine

bubbles, and made to pass through a column of liquid.

This method of treating a liquid with a gas has, at first sight, the great disadvantage, that the mechanical power required for the production of the contact is very great. Thus, for instance, it requires the expenditure of 998 kilogrammeters to propel one cub. meter of gas through a column of water one meter deep; so that the work done in propelling one kilogramme of gas through one meter of liquid is equal to that of lifting one kilogramme of water 1000 meters high. When, in addition to this high expenditure of work per cub. meter of gas, we consider that every cub. meter of liquid has usually to be treated with an enormous bulk of gas varying in different technical processes from 200 to 20,000 cub. meters, we need not be surprised that now and then attempts are made to avoid using this apparently very costly method.

The apparatus used for this mode of treating liquids with gases is usually extremely simple, and it cannot be too simple. In most cases the apparatus consists of a vertical cylindrical vessel holding the liquid. At the bottom of the vessel is usually placed a system of pipes ending in numerous small orifices, so as to spread the gas and distribute it equally over the area of the vessel. The gas is delivered by an air pump, which compresses it to a pressure slightly greater than that due to the depth of the column of liquid through which the gas has to rise. In other cases the vessel is closed at the top, and the space over the liquid is exhausted, so that the gas is drawn through the liquid instead of forced through. In other instances, for example, in the apparatus Mr. Chance used for carbonating the mixture of magnesia and calcium chloride, the vessel is closed at the top, and provided with a loaded valve, so as to enable the liquid to be treated under a much greater pressure than that due to the column of liquid contained in the vessel. In all these cases, the work to be done, and the result obtained, are very different.

One great difficulty presents itself at once when we wish to deal arithmetically with the question of efficiency of this kind of apparatus. It is impossible to measure the surface which the gas bubbles present to the liquid; we can only make some approximate estimation. But it is possible to ascertain how the surface of the gas bubbles varies under different circumstances, such as depth of liquid, nature of the liquid and the gas. I have made this the subject of a few experiments. The first question which I attempted to answer was, How does the size of a gas bubble issuing from a given orifice vary as that orifice is immersed to different depths in the same liquid? I found that the diameter of the bubble was always the same, however great I made the depth of the column. I varied the depth of the column from 0.2 meters to 10 meters, and I found no greater difference than 1 per cent. in the value of the diameter of the bubbles. I repeated the experiments with various orifices, which, of course, gave bubbles of different diameters; but one and the same orifice always gives bubbles of one diameter, whatever the depth of the liquid above the orifice may be. The same result is obtained whether the orifice is simply the end of a straight pipe, or whether it is a pin hole in a sheet of platinum; the bubbles from the pin hole will be smaller, but they are all equal to, and independent of, the column of liquid above. I also found that for a given orifice the size of the bubbles was independent of the nature of the gas. Whether the gas was hydrogen, air, coal gas, or carbonic acid gas, the bubbles from the same orifice were equally large. The only great alteration in the size of the bubbles is produced by a change in the liquid itself. A very small addition of alcohol to water will materially reduce the size of the bubbles formed by a given orifice.

These experiments lead to the conclusion that the size of the bubbles obtained from any gas by passing it through a given distributor is independent of the pressure above the distributor. Of course, as the bubbles rise they expand, and the amount of this expansion will depend upon the height of the column. But at the point at which the bubbles leave the distributor, their diameter will only depend upon the size of the openings of the distributor, and upon the viscosity of the liquid.

The next question which I tried to settle by experiment was, How do the bubbles move upward, is their velocity accelerated, or retarded, or uniform? And, if possible, I wanted to obtain its magnitude.

The velocity of bubbles in a wide glass tube I found so small that, by means of a metronom beating 240 beats a minute, I could obtain some approximate idea of the velocity. I found no appreciable acceleration; the motion was, as far as I could judge, perfectly uniform. I ascertained the velocity to be about 0·3 meters per second, or not quite one foot per second. I felt, however, that the results of so rough an experiment would not form a secure basis for any important calculations. Conclusions from an experiment, where one bubble was made to rise, and only one, through a quiescent liquid, might not apply to a case where thousands of bubbles are on their way through a liquid in violent agitation, as we have it in a Weldon oxidiser. I therefore endeavoured to ascertain the average velocity of such bubbles in a Weldon oxidiser. This, at first sight a difficult problem, is really very easily solved. Owing to the slow motion of bubbles through the liquid, there are a considerable number of them on their way through the liquid at any moment, they displace a certain amount of liquid, consequently the level of the liquid rises. If we measure the amount which the liquid rises, ascertain at the same time the rate at which the gas is pumped through the liquid, also the height of the liquid when quiescent, and the area of the vessel, we have all the data needed for calculating the average velocity of the air bubbles in the Weldon oxidiser. Clearly the amount of liquid displaced gives us the amount of gas in the liquid at any moment, from the distributor to the surface of the liquid. Fancy you followed with your eye the bottom layer of bubbles as they gradually rise; by the time this layer has arrived at the surface, the whole vessel has been supplied with as much gas again as it contained when that layer was at the bottom; therefore, the time which it takes for the air pump to supply that gas is also the time which that layer of bubbles required to rise to the surface.

If D is the depth of the liquid when quiescent, and d the amount it rises, when gas is blown through it at the rate of C volumes per second (measured at the average pressure in the liquid) and if A is the area of the vessel, the amount of the liquid displaced will be A.d., the number of seconds which it will take to deliver that amount will be $\frac{A.d}{C}$ and in $\frac{A.d}{C}$ seconds the gas bubbles rise through the total height D + d., consequently their velocity is

$$v = \frac{C(D+d)}{A.d.}$$

I will give the results of one such experiment, which serves as a numerical example. An oxidiser was charged to a depth of 15 feet, it had an area of 100 square feet; air was blown into it at the rate of 14·8 cubic feet (measured at a pressure of 7½ feet of liquid). I found the charge to rise 2·66 feet. Thus the displacement was 266 cubic feet, and the time necessary

to deliver this amount 18·3 seconds, this being also the time necessary for the bubbles to pass through a column now 17·66 feet in height. The average velocity is thus $\frac{17 \cdot 66}{18 \cdot 3}$ or ·95 feet per second. This shows that the average velocity in such apparatus does not differ materially from that found in the experimental tube. (Before passing on with my subject, I will just draw attention to the fact, that the velocity of bubbles being taken at 1 foot per second approximately, the formula just given may be used for calculating the amount which a liquid will rise in any vessel when gas is blown through at a certain rate; the formula for that purpose assumes the form

$$d = \frac{D.C}{vA. - C})$$

Thus my experiments made also with various depths of liquids have shown me that for practical purposes the velocity of these bubbles is nearly constant, and about 0·3 meters per second.

Owing to the fact that the diameter of the bubbles is always the same whatever the pressure is, one cubic meter of gas measured at atmospheric pressure will not always yield the same surface in the same distributor, that depends upon the depth of the column of liquid. For although the bubbles are always of the same diameter, the weight of gas contained in one bubble is of course greater the greater the depth of the column of liquid.

As the bubbles rise through the column of liquid they expand, and thus enlarge their surface. At the same time the pressure diminishes. It is not difficult to calculate the total number of units of contact thus produced for each bubble in rising. If this is multiplied by the number of bubbles which would make up one cub. meter of gas at ordinary barometric pressure, a formula is readily found, which will give the number of units of contact produced per cub. meter of gas.

For the three modifications of apparatus in which bubbles are made to rise through the liquid, these formulæ are the following three:—

(1.) For blowing gas through a column of depth D, the barometric pressure being b meters of the same liquid, and the velocity of bubbles 0·3 meters a second k the co-efficient of distributor—*i.e.*, number of square meters it produces per cub. meter of gas, when the bubbles issue at atmospheric pressure.

(1.) Units of contact per Cub. meter gas...... $= \frac{10}{4} k . b^2 \left(1 + \frac{D}{b} - \sqrt[3]{\frac{b}{b+D}}\right)$

(2.) If the gas is pulled through the vessel by a vacuum pump, the symbols having the same meaning—

(2.) Units of contact per Cub. meter gas .. $= \frac{10}{4} k . b^2 \left(1 - \left(\frac{b-D}{b}\right)\sqrt{\frac{b-D}{b}}\right)$

(3.) If the gas is compressed and passed through a column of liquid of depth D, and allowed to escape through a loaded valve maintaining an absolute pressure p at the surface of the liquid, the units of contact will be—

(3.) Units of contact per Cub. meter gas.. $\frac{10}{1} k . b \left(\left(D + p \left(1 - \sqrt[3]{\frac{p}{p+D}}\right)\right)\right)$

Such formulæ in themselves convey to those not accustomed to read them no information whatever. I shall, however, give below a numerical comparison, which will show a striking difference in the cost of the three methods.

I have defined the efficiency of a piece of apparatus as the number of units of contact produced per kilogrammeter of work spent. If the amount of work to be done per cub. meter of air is known, we have only to divide the units of contact by the number of kilogrammeters to obtain the efficiency.

Supposing, in the first instance, we had a vessel holding 4 meters a liquid of sp. gr. 1·03, for which $b=10$, at the bottom of which we had a distributor yielding bubbles of 6mm. diameter which yields per cub. meter 1000 square meters of area, so that $k=1000$. The number of contacts which would be obtained—

1. If the vessel is open at top, and the gas forced through, it would be according to formula (1) 126,525 per cubic meter.

2. If the vessel is closed at top, and the gas drawn through by a vacuum pump, according to formula (2) 123,485 per cubic meter.

3. If the vessel is closed at the top, and the gas escapes through a loaded valve at a pressure of 1 atmosphere = 14·7lb. to the square inch = 29·4lb. absolute or = 20 meters of our liquid, we have 129,475 per cubic meter.

These numerical results show that as far as the intimate contact is concerned, the same distributor will produce very nearly the same number of contacts whichever way it is applied. I discovered this fact—viz., that a given distributor produces the same result with the same height of column absolutely, whether the pressure above that liquid be 35lb. to the square inch or *nil* first, on experimenting on the large scale with a column of liquid 10ft. deep, containing caustic alkali which had to be carbonated. The percentage of carbonic acid absorbed is independent of the pressure of the carbonic acid gas, whichever of the three modes of applying gas to the liquid is chosen. But when we come to consider the power employed to produce this contact, we find it for the three cases to be:—

1. For simply blowing the gas through four meters' depth of liquid per cubic meter of gas, 3643 kilogrammeters.

2. For simply pulling the gas through four meters of liquid, 4894 kilogrammeters.

3. For keeping the liquid under a pressure of one atmosphere . . . 10,274 kilogrammeters.

The efficiency of the apparatus is therefore:—

No. 1..........	31·73	units per kilogrammeter.
No. 2..........	25·23	„
No. 3..........	12·60	„

These results show that the method of simply blowing air through a liquid is by far the cheapest of the three. Theoretically, the cost decreases as the column of liquid is increased, for methods one and three. Thus for 10 meters' depth of liquid, the efficiency of Nos. 1 and 3 become—

No. 1..	38·12	units of contact per kilogrammeter.
No. 3..	23·19	„ „

but practically the efficiency becomes less and less, owing to the difficulties which present themselves when gases have to be pumped against very high pressures.

The efficieucy of the second modification diminishes very rapidly as the column is increased in height. That method is always to be avoided whenever it can be avoided. It is usually only employed where corrosive gases have to be absorbed, so as to avoid contact between the propeller and the corrosive gas.

There is one great drawback in all three modes: it is difficult to have a perfect counter-current, which for most chemical reactions is of very great advantage. By counter-current, I mean two streams moving in opposite directions, so that the saturated liquid leaves the apparatus where the fresh gas enters; whereas, the exhausted gas leaves the apparatus where the fresh liquid enters. This cannot be arranged to perfection with the method of gas bubbles, but in every other respect that method is little inferior to any.

DISCUSSION.

In answer to questions, Dr. HURTER said that the pressures mentioned in his paper were absolute, and included barometric pressure; thus, he would call an absolute pressure of gas 4, which was capable of overcoming a column of water 4 meters in height.

Dr. CAMPBELL BROWN, while admitting that the paper was a model of philosophic argument and close reasoning, felt that the results arrived at were certainly unexpected. He would like to know whether air and water only, or whether soluble gases, such as chlorine, had been used; as the latter would complicate the results, but at the same time render them more valuable.

The CHAIRMAN asked how the force was measured in the case of a vacuum.

Mr. THOMPSON asked whether the size of the bubbles bore any ratio to that of the apertures? Also, supposing that an excess of force above that necessary to overcome the column of liquid were used, would the velocity of the bubbles be materially increased? In making some silicofluoric acid a short time since he had found that when he inserted his delivery pipe under mercury covered by water, the bubbles, which at first were large, diminished rapidly in size, until at last, when the gas became pure, they were reduced to very small dimensions.

Dr. HURTER, in answer to the Chairman, said that his figures were theoretical; in practice this efficiency was never realised, and the force required vastly exceeded that deduced from calculation. In answer to Mr. Thompson's question as to the size of the bubbles, he had not as yet satisfactorily determined their relation to that of the apertures. As regarded velocity, force above that required to overcome the pressure of the column was useless, as friction soon reduced any extra velocity so obtained to that of ordinary floatation; as regarded silicofluoric acid, as the gas increased in purity the bubbles diminished, until, with pure gas, they saw no bubbles at all.

Dr. HEWITT said that the late Dr. Angus Smith had been in favour of absorbing hydrochloric acid by means of a spray, and had shown him a design of apparatus to effect absorption by such means. Dr. Hurter evidently dissented from this notion. If, then, some definite law could be established, these questions would cease to become mere matters of opinion.

The CHAIRMAN said that the meeting were much indebted to the author for his valuable communication. He must confess his surprise at the figures given for the disproportion between the amount of force expended when gas was passed through a liquid in the one case, and presented in the form of spray in the other. He had always been in favour of the former method, but had no idea that the difference in cost was so great. Corrosive gases, however, required special methods of absorption. Many patents had been taken out for absorption in the form of spray, but it was well that manufacturers should be made aware that such methods involved great cost.

Manchester Section.

Chairman: Sir H. E. Roscoe.
Vice-Chairman: I. Levinstein.
Committee:

R. F. Carpenter.	D. B. Hewitt.
C. Estcourt.	C. Schorlemmer.
H. Grimshaw.	Watson Smith.
B. W. Gerland.	L. Siebold.
Peter Hart.	Wm. Thomson.
T. Jackson.	D. Watson.

Local Secretary:
J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885—86.—First Tuesday in each Month, at 7 P.M.

December 1.—A. H. Allen—"Further Notes on the Chemistry and Analytical Examination of Fixed Oils."
Watson Smith—"The Violet Stains appearing on Sized Cotton Cloth" (*Experimentally Illustrated*).
Notices of papers and communications for the meetings to be sent to the Local Secretary.

THE opening meeting of the session was held in the Chemical Club Rooms at the Victoria Hotel, on Tuesday evening, 3rd November. The Chairman (Sir Henry E. Roscoe) in the chair.

The CHAIRMAN, after congratulating the members on the convenient situation of their meeting room, and on the active and promising condition of their Section, proceeded to point out the success achieved by members of the Society at the International Inventions Exhibition. The award of gold and silver medals in such large numbers to members of our Society was a very satisfactory state of things, as it betokened activity and showed that in the essential conditions of originality and of practical power the industrial chemists of England were not behind those of other countries. He then alluded to the great loss which the Society had sustained in the lamented death of their late President, Mr. Walter Weldon, and paid a well-deserved tribute of affectionate respect to the memory of one who had raised high the standard of science in its applications to the most important of our national chemical industries, and whose name would for ever be honourably associated with those industries, and with the Society which he helped to establish and did so much to adorn.

NOTE ON ANTIMONY COMPOUNDS USED IN DYEING AND PRINTING.

BY B. W. GERLAND, PH.D.

THE use of aniline colours in cotton dyeing and printing was largely extended by the introduction, through Messrs. Brooks & Co., of this city, of tartar emetic for fixing baths. The efficient constituent of the tartar emetic is antimonious oxide, which forms an insoluble lake of great resistance with the colour-tannate. The other constituent, bitartrate of potass (a rather costly substance, and likely to become dearer in consequence of the spread of the vine louse and increased demand), only serves to keep the metallic oxide in solution, and is lost with the waste waters. As the metallic oxide only amounts to 43·7 per cent. of the salt, its price in this form is very much enhanced. At the time, tartar emetic was the only compound of antimony in the market possessing the required qualities, and efforts were now made to discover one combining cheapness with these properties. As the outcome of these we have now two substitutes that are largely sold. One is the fluoride of antimony proposed by Mr. S. Mellor, of the Magnesium Metal Company, and manufactured in three forms by this firm—the acid and the neutral liquids, and the third as a white crystalline powder. The latter dissolves readily in boiling water, and like the others, can be diluted with water without separation of antimonious oxide. I am informed that of all antimony preparations these are the cheapest, and give satisfaction in the absence of light colours and ultramarine, which is discharged even by their dilute solution. I was anxious to experiment upon these fluorides, but the samples kindly sent by the Company only arrived yesterday. The other substitute for tartar emetic is the double salt of antimonious and potassic oxalate, supplied largely by Messrs.

Rudolph Koepp & Co., of Oestrich on the Rhine. They submitted this preparation to the judgment of Dr. Noelting, Professor of the School of Chemistry in Mühlhausen, and received a very favourable report. According to this, the double oxalate did not only do the work as efficiently and as well as the tartar emetic, but it could, moreover, replace the latter weight for weight, although containing only a little over one-half the quantity of antimony. Dr. George Hirzel, of the Augsburg Printworks, instituted comparative trials between the oxalate and tartrate, and arrived at results differing widely from Noelting's (*Chem. Zeit.* No. 41, page 325). Noelting's reply soon followed, and as this enters fully upon all points, and gives also the opinions of Mühlhausen printers, I cannot do better than lay a full extract of the same before you.

Hirzel mentioned trials on a large scale with printed pieces, which were fixed in baths containing respectively 10grm. tartar emetic, 10grm. antimony oxalate, and a third containing 19grm. of the latter per litre. The quantity of antimony in this bath was equal to that of the 10grm. tartar emetic bath. The pieces taken through the tartar emetic bath showed the fullest and brightest colours; those fixed in the weaker oxalate bath were weaker in colour, and even the colours of those which had been through the stronger oxalate solution were not equal in depth to the first lot. Similar results were obtained in a neighbouring printworks, and there a want of brilliancy in the colours was noted in the pieces fixed with the oxalate in comparison to those fixed in the tartrate. No better results were obtained by adding chalk, soda, or other neutralising agents to the fixing baths. Noelting, after referring to the results obtained in his laboratory, states that these have been completely verified in the Mühlhausen Printworks, where the antimony oxalate is now used regularly, and explains the greater efficacy of the antimonious oxide in the oxalate by the greater inclination to disassociation of the latter. The fixation of the tannin is consequently quicker and more complete, but the baths are sooner exhausted, which, however, is an advantage, since the tartar emetic baths have oftener to be renewed before exhaustion, in consequence of having become fouled by colours stripped from the prints. The oxalate, according to the experience of Mühlhausen dyers, can also be used for uni-dying, where the cloth mordanted with tannin is taken through the antimony bath and then dyed. In this case the oxalate also replaces an equal part of tartrate. Mr. Felix Weber, in a paper on comparative trials of antimony preparations, laid before the Chemical Committee of the Industrial Society of Mühlhausen, pointed out the applicability of the antimony oxalate in every case. Noelting accounts for Hirzel's unfavourable results by the large quantities of oxalate used in the trials—viz., 10grm. and 19grm. per litre, whilst 5grm. is quite sufficient, and is supported herein by the experience of colourists, who find that such strong solutions yield worse results than weaker solutions, and that, specially in steam colours, the colours associated with tannin suffer. The statement of Hirzel's that the colours fixed by the oxalate are less brilliant and fast than those fixed by tartar emetic, is contrary to the experience of Mühlhausen. The separation of insoluble basic antimony oxalate complained of by Hirzel has no disadvantage, since its precipitate fixes the tannin perfectly. Trials laid before the Chemical Committee by Mr. A. Kesters, repeated and confirmed by Mr. Weber, prove that freshly-precipitated antimonious oxide suspended in water, causes a complete fixation of tannin. Noelting does not expect that a few unfavourable results will cause the antimony oxalate to be abandoned, after having become of general and extensive use among the printers of Mühlhausen, and winds up his reply with the advice to practical men—"Try for yourselves."

This advice is to be taken to heart by printers and dyers most particularly. In these arts we have to deal with conditions and forces of which our knowledge is at best hazy, and speculations based upon such foundation can only become of value when tested by experiment.

As regards the fixation of colour tannates by tartar emetic, it is asserted that the antimony of the latter combining with the tannate forms an insoluble compound, an antimony lake similar to baryta being precipitated by sulphuric acid. That this is not so, but that other forces, perhaps attraction of the fibre, come into operation is evident from the following observations:—

A solution of tartar emetic, ten to 1000, is precipitated by a strong tannin solution, one to five, but not by one of one-tenth that strength.

A solution of the oxalate, fifteen to 1000, containing the same amount of antimony (see analysis below) is still precipitated by the weaker tannin solution. But a solution of three to 1000 is precipitated only after some time.

The colours, at least some, combine with the antimonious oxide, forming insoluble compounds in solutions of both the oxalate and the tartrate, but the limit of dilution is in this case even less favourable than with tannin. The presence of gum does not assist the separation of the antimony tannate. It is, however, easy to precipitate every trace of antimony from the weakest solution of the oxalate or tartrate by means of tannin, and *vice versâ*, by adding a small quantity of some neutral salt—for instance, sodium chloride. This precipitate is insoluble in water and in an excess of the antimony solution, but soluble (and this is of great importance to the fixing process) in an excess of tannin. Considering these experiences, I recommend for the fixation of tannin or tannin colours in antimoniacal baths an addition of common salt, either to the colour or to the bath, and expect that from two to five per cent. of the water will be found sufficient.

In conclusion, let me add the result of an examination of the oxalate in crystals, received from Messrs. Koepp & Co.

These crystals are well formed and transparent. In the steam bath they soon become opalescent, then opaque white, with mother-of-pearl lustre, and continue to lose weight for a very long time (14 hours for 1·5grm.). No further loss occurs at 150°, and no oxalic acid is dispelled at that temperature. The composition agrees with that of Souchay and Lossen's salt: $3K_2O, 6C_2O_3, Sb_2O_3, 12H_2O$ (*Ann. Pharm.* 105, 250), with the exception of water, which amounts to only 2·57 molecules, as the following tables will show:—

	Found.	Calculated for.
Antimonious oxide ..	25·83	Sb_2O_3 .. 292 .. 25·54
Potass	23·13	$3K_2O$ .. 282 .. 24·69
Anhydrous oxalic acid	38·11	$6C_2O_3$ .. 432 .. 37·82
Water (loss at 150°)....	11·90	
	99·97	

DISCUSSION.

Mr. MELLOR said that his attention had been directed to the oxalates of antimony about six years ago, and since then more than a hundred samples had been tested in his laboratory. The first samples contained 12·5 per cent. of antimony (estimated as metal), later samples contained about 18 per cent., but now they could be bought containing 22 to 22½ per cent. Speaking in round numbers, the percentage of antimony estimated as metal, and not as oxide,

of the three salts of antimony mentioned by the author, were antimony oxalate (first quality) 22 to 22½ per cent., tartar emetic 35 to 35½ per cent., and antimony fluoride 39 per cent. Inasmuch as it was the antimony contained in any of these salts which served to fix aniline greens and blues, the buyer had in these percentages a standard of value for the article he was using. Considerable annoyance and loss had occurred to printworks managers from the sale to them of the oxalate as true tartar emetic, and its indiscriminate use in all styles of work. He would therefore strongly urge them not to use tartar emetic substitutes in any prints or combination of patterns which involved the use of ultramarine blue, dove, or brown colours, but with all other colours the substitutes would serve with equal advantage, always provided that the percentage of antimony was equal to that contained in tartar emetic.

Mr. Walker had found by experience that it is best not to use the oxalate to fine greens and reds in combination, but for other colours the results had been very satisfactory.

Mr. Levinstein felt that the question whether antimony oxalate could in practice replace tartar emetic, weight for weight, in fixing tannate lakes or materials containing tannic acid, notwithstanding that the tartar emetic contained nearly twice as much antimony oxide, was not alone of interest to dyers and printers, but also to English manufacturers of antimony compounds. So far as he was aware, the oxalate was not made in this country, and no doubt its manufacture would be gladly taken up if English makers could be sure of a market. Opinions were, however, divided as to its action. Noelting, and with him O. N. Witt, asserted, as they had heard, that the oxalate could fully replace the tartar emetic, not only for fixing tannate lakes, but also in uni- or single-colour dyeing. On the other hand, Hirzell holds the opposite view, and his experiments had been in some degree confirmed. Noelting tried to explain Hirzell's failure by attributing it to the use of too concentrated solutions. Clearly, then, this divergence of views pointed conclusively to the necessity for further investigation. Did equal quantities of oxalate really replace equal quantities of tartar emetic; and if so, could the former be used in all instances? According to Witt, oxide of antimony in the form of oxalate fixed tannate lakes more easily, or, in other words, the oxalate dissociated its antimony oxide more readily than tartar emetic. It was well known that in one case the residual product of decomposition was acid potassium oxalate, and in the other acid potassium tartrate. What was the action of these residuals on colours? In uni-colour dyeing, where fabrics were first impregnated with tannic acid and immersed in tartar emetic, it might be practicable to keep the latter in permanent use, unless Witt's contention, that antimony tannate dissolved more easily in acid potassium tartrate than in acid potassium oxalate, were proved to be just. Even this, however, was not conclusive, as it would be quite possible to find means to assist in the dissociation of the salt, or counterbalance the injurious action of the residual acid potassium tartrate. These points should be set at rest, and in the meantime he would urge dyers who still adhered to tin preparations, to make themselves better acquainted with the action of antimony compounds on tannic acid or sumac, by which undoubtedly more brilliant lakes were formed than by either stannate of soda or muriate of tin. It might be inferred from the author's paper that Messrs. Koepp first introduced this oxalate. This was, however, not the case, as the salt had wittingly or unwittingly been in use in England for years. To Messrs. Koepp, however, must be granted the credit of being the first to produce and sell it under its proper name.

Dr. Grossman quite agreed with Mr. Levinstein as to the importance of proving the comparative values of oxalates and tartrates, and thought that there was no one better qualified for the task than the author. Many years ago Dr. Gerland had published a volumetric method for the quantitative determination of tannin by means of tartar emetic, and had then pointed out the influence exerted by neutral salts upon the precipitation. Having regard to this influence of neutral salts on the precipitation of tannin and antimony, it seemed to him that the divergences of opinion mentioned might arise from the fact that, in the recorded experiments, various disturbing ingredients had been present, and influenced the reaction. Whatever might be the result of the discussion, he trusted that chemists would not lose sight of Dr. Gerland's quick and reliable method of estimating tannin, which hitherto had not met with the recognition which it deserved.

Mr. Watson Smith drew attention to the fact that in the August number of this Journal, page 493, an abstract of a paper in the *Bulletin de la Soc. Ind. de Mulhouse* (1885, 318), appeared, entitled, "The Use of Oxalate of Antimony in Printing." This paper, by E. Jacquet, contained directions for the use of antimony oxalate in printing, and these were of value as arising from the practical experience of a Mühlhausen expert.

The Chairman thoroughly agreed with Mr. Levinstein in urging the necessity of further experiments to determine the efficiency and economy of the rival salts.

ON THE VALUATION OF CRUDE NAPHTHAS OF COMMERCE.

BY GEORGE E. DAVIS.

Crude naphtha—first runnings, or the light spirit of coal-tar—is the raw material from which most of the purified benzols of commerce are prepared, and as it varies very much in quality, it is generally sold by the indications yielded by some chemical test.

The method usually employed is to distil a quantity (generally 100cc.) in a tubulated glass retort, and to catch the quantity distilling over, up to a temperature of 120° C., the bulb of the thermometer being immersed the whole time in the boiling liquid. What is considered an average sample of crude naphtha should yield, on distillation, 30 per cent. at 120° C., and this is generally the basis on which this article is sold, so that contracts are usually made at so much per gallon for 30 per cent., with a rising or falling allowance per degree (or every one per cent.) within reasonable and pre-arranged limits.

Crude naphtha varies in quality according to the source of the tar from which it is distilled, and writing from the examination of a large number of samples extending over upwards of ten years, and from the results of working on the large scale, I can confidently say that the foregoing method of testing is both illusory and unsatisfactory. Sellers may prefer the test on account of its simplicity, but buyers of crude naphtha and rectifiers of benzol usually have some secret method of their own, which they employ when offering for a parcel by sample, and so are often able to avoid making a doubtful purchase. In the case of contracts it is different—if say twelve monthly deliveries have to be made, each parcel may vary

widely in its composition to the detriment of the purchaser, and yet the seller be well within the four corners of his contract.

Such a state of things needs reforming, and now that crude naphtha is practically unsaleable, this seems the time for inaugurating a change. It must not be forgotten, however, that the sellers of crude naphtha and the refiners of benzol are not always brought into contact with each other. Most of this business is in the hands of agents, who write round to sellers for samples of what they have to dispose of. These samples are tested (generally by a lad in the office) for what they will yield at 120° C., and offers are then requested from the refiners. Here then is an example of what all traders should do—buy in the cheapest market and sell in the dearest—if they can do so. The refiner would be able, in most cases, to draw his own inferences, if a sample was sent with the inquiry, but this is not always done, the test alone being sent.

In the case of no sample being sent, the purchase of a parcel of crude naphtha is a very risky thing, and can only be dealt with commercially, by allowing sufficient margin to cover the risk—this is the seller's loss. On the other hand, it is not the only quantity to be taken into consideration, as even with samples before them distillers vary exceedingly in the prices they offer for one and the same parcel. No doubt this is in a great measure due to various methods of valuation, and if the lowest value offered yield but an honest profit, the highest must be a failure. I say a failure guardedly, not inferring an absolute loss, as a rectifier may have to make future deliveries at good prices, which may warrant him offering more than his neighbour; but if he pays for his crude material more than the market price of the day at the moment of purchase, he is not a shrewd financier.

Crude naphtha is valuable only for the benzene, toluene, and solvent naphtha it contains, so that an adequate method of valuation should take them all into consideration. The distillation test to 120° C. will not differentiate these products, nor will it give any idea of what can be positively realised on the large scale. A considerable portion of the bulk, too, is often eliminated during the washing with acid and soda, and of this varying quantity the test takes no account. How can it then stand its ground?

As an average of many samples from different parts of England, the following distilling points are given :—

Sp. Gr.	100°	110°	120°	140°	170°	200°
·905	2	14	33	57	80	92

The distillation test at 120° C. could not be applied in the case of a very rich naphtha, such as that obtained from the gas in the carbonisation of coal, for in this case there is but a small proportion of "solvent," of which the rectifier expects to get his due share.

The average test of a large number of samples of crude benzol, obtained by my process at the Rockingham Gas Works, gave the following test, showing how little "solvent" there is in it :—

Sp. Gr.	100°	110°	120°	140°	170°	200°
·890	61	83	90	96	98	99

There is another class of benzols or naphthas often requiring valuation—viz., "twice-run naphtha," which term may mean almost anything, and yield products even more various in their character than the products direct from tar. Some makers of it collect the lighter portions in one tank, and the "tailings" in another, the first, being richer, is sold by sample, the second generally goes to those who have been foolish enough to contract exclusively for the 120° C. test. The following are some distilling points of this class of naphthas :—

Sp. Gr.	100°	110°	120°	140°	170°	200°
·878	0	17	41	72	91	99
·888	3	23	46	71	88	95
·901	2	20	40	62	80	90
·901	0	9	29	57	81	95

It may be inferred, with safety, that the simple specification of so much per cent. distilling at 120° C. is no guide whatever to the amount of valuable products the rectifier can get from a parcel.

Some years since I was asked to verify the certificates of a number of deliveries of crude naphtha by means of a specified test, which, being much better than that just described, I will give in detail :—100cc. of the naphtha to be distilled in a 200cc. flask, with a thermometer arranged so that the bulb shall be just off the bottom of the flask. The distillate to be caught in a 100cc. graduated measure, and the yield at the following points taken :—100°, 110°, 120°, 140°, 170°, 200°. The quantity which shall have passed over at 140° C. is to be again distilled, and the yield at 100° C. and 120° C. noted. All which passes over up to 100° C., in the second distillation, is called *Benzol*: that which passes between 100° C. and 120° C., in the second distillation, is called *Toluol*. *Best Naphtha* (N_1) is that which passes between 120° C. in second distillation and 170° C. in the first. *Second Naphtha* (N_2), that caught between 170 C.—200° C. in the first distillation; and *Creosote* (C), the difference between 100cc. and the yield at 200° C. in the first distillation.

The following are some tests, by this method, of samples which passed through my hands at that date :—

Sp. Gr.	First Distillation.						Second.		Products.				
	100°	110°	120°	140°	170°	200°	100°	120°	B	T	N_1	N_2	C
·886	2	22	42	67	88	94	23	53	23	30	35	6	6
·893	11	30	50	72	88	95	27	56	27	29	32	7	5
·903	2	14	23	56	78	92	23	42	23	19	36	14	8
·915	0	2	11	29	73	94	7	26	7	19	47	21	6
·917	2	16	31	57	75	87	22	43	22	21	32	12	13
·940	2	10	21	42	59	69	23	36	23	13	6	17	10

Now although this method appeared to suit certain buyers it seemed to me necessary to examine a large quantity of these products, and for this purpose five bottles were used to collect the different fractions from many samples. The distillation of them showed as follows :—

B	85°	90°	95°	100°	110°	120°
	2	48	71	80	90	95
T	100°	110°	120°	130°	135°	
	47	75	86	91	96	
N_1	130°	140°	150°	160°	170°	180°
	13	43	63	79	91	93
N_2	160°	170°	180°	190°	200°	
	2	31	55	71	87	

The creosote in the fifth bottle crystallised into a solid mass. The above shows clearly that the method is not exact enough for times of great depression and minimum profits, and, moreover does not indicate truly the maximum price which may be offered to the seller. The "benzol" is only of 80 per cent. quality, while the "toluol" is nearly a 50/90 benzol. The naphthas (N_1 and N_2) are but mixtures of solvent and light oil, which have to-day very different valuation figures.

As a comparison to the foregoing, I have lately applied the method to the valuation of the crude benzol produced from coal gas, and have arrived at the following figures :—

B	85°	90°	95°	100°	105°	110°	120°		
	42	78	88	92	95	96	dry.		
T	100°	110°	120°	130°	135°	145			
	45	71	84	90	93	95			
N_1	115°	120°	130°	140°	150	160	170°	180°	190°
	4	15	36	52	63	72	78	83	88
N_2	140°	150°	160°	170°	180°	190°	200°		
	4	17	30	43	56	68	78		

The creosote was a completely solid and hard cake.

These tests show that although the methods usually employed may give the distiller some faint guide of the quantities to be expected from the still, they can scarcely be called scientific, and for one good reason, that they do not take into account the products eliminated during the washings with acid and soda, the loss in these operations being often very great. To take a case in point—1500 gallons of crude naphtha (for sake of identification we will call it HB) tested :—

B	T	N_1	N_2	C
25	23	32	10	10

This quantity, after washing with ROV and soda, measured 1200 gallons, and tested :—

B	T	N_1	N_2	C
26	14	24	9	27

When this quantity was worked in a still of the best construction, the yield was :—

90% benzol .... 318 gallons = 23%
50% benzol .... 362 ,, = 24%
Solvent naphtha ...... 156 ,, = 10%

The test would therefore lead us to suppose that much more solvent naphtha could be obtained than was actually the case.

In another instance, 1500 gallons of crude benzol from gas of our own make, tested :—

B	T	N_1	N_2	C
70	6	9	4	11

After washing with R.O.V and soda it measured 1440 gallons, and tested :—

B	T	N_1	N_2	C
69	5	9	1	11

When worked in the still it yielded :—

90% benzol .... 1166 gallons = 77·7%.
Solvent naphtha .... 33 ,, = 2·2%.

Here the test indicates much nearer the yield on the large scale than with crude naphtha ; but there is very little, if any, of the crude benzene from carbonising to be found in the market.

The method I have found to be of great service in the valuation of crude naphthas is as follows :—200cc. of the crude naphtha are agitated with 20cc. of concentrated oil of vitrol in a globular, stoppered separating funnel of 300cc. capacity. After agitating well for five minutes, allow to settle, and run off the acid carefully so that nothing is lost. (It is better sometimes to give two washings with R.O.V. of 10cc. each, instead of one washing with 20cc.) Now wash twice with 30cc. of water each time, running off the wash waters very carefully, then add 30cc. caustic soda solution (sp. gr. 1060) and again wash with water. Pour the washed naphtha into a measuring jar and determine the percentage loss. All is now ready for the distillation. Measure off 100cc. of the washed naphtha, less the percentage loss (thus if the loss has been 10 per cent. 90cc. will have to be taken, and so on) and place in a 200cc. flask fitted with a delicate thermometer and Glinsky's or Le Bel Henniger's fractioning tubes, connecting it with a Liebig condenser of the ordinary pattern. Heat the flask with a rose-burner, and so regulate the flame that a drop distils over about once in every two seconds. Carry the distillation on until the thermometer has risen to 120° C., catching the distillate in a graduated jar. At this point change the receiver, and catch all that comes over up to 170° C.

The distillate to 120° C. consists substantially of benzene and toluene ; that portion distilling between 120° C. and 170° C. is solvent naphtha, the remainder creosote. The "solvent" produced in this small apparatus will show first drop at 125° C. and 90% at 160° C., which is usually the quality worked for on the large scale.

The composition of the distillate to 120° C. will vary somewhat with every sample of crude naphtha operated upon. In my own case, the quantities yielded by each analysis were collected from many samples, and when mixed and tested in the usual way employed for 90% and 50% benzols, showed 64% at 100° C. and 93% at 120° C., and I have found this method so handy in practice, that it is easy, without any supervision, to run the specified quantities of 90's and 50's from the still direct, without any fear of mistakes.

When operating upon "crude benzols" from coal-gas, the quality is much higher, and generally runs

	Sp. Gr.	Old Method.	Improved Method.					New Method.				
		at 120° C.	B	T	N_1	N_2	C	Loss.	at 120° C.	Test at 100° C.	Solvent.	Creosote.
Crude Naphthas	·886	42	23	30	35	6	6	13·5	50	60%	23	27
	·902	31	19	22	35	15	9	18·5	46	59	19	36
	·908	29	17	23	39	13	8	10·5	45	61	23	32
	·924	32	30	13	27	15	15	16·5	47	58	13	40
Crude Benzols.	·885	89	80	5	11	2	2	6·7	82	91	2	16
	·895	77	70	6	9	4	11	7·5	77	92	2	21
	·900	71	61	9	9	5	13	8·5	71	93	4	25
	·909	61	55	12	10	3	10	7·0	67	91	6	27

94% at 100° and 98% at 115° C. The results of the older methods, as compared with the new, are given in table on previous page.

In order to rapidly estimate the quantity of 90%, 50%, and toluol which may be run from the still, I have constructed the following table:—

MIXTURES OF 90% BENZOL WITH 50/90 BENZOL.

90%	50/90.	First drop.	% at 100° C.	% at 120° C.
0	100	92°	50	90
5	95	92	51	92
10	90	91	51·5	92
15	85	91	53	92
20	80	90	55	92
25	75	90	60	93
30	70	90	65	93
35	65	90	67	94
40	60	88	69	94
45	55	88	70	94
50	50	87	71	94
55	45	87	73	94
60	40	86	76	95
65	35	86	78	95
70	30	86	79	96
75	25	85	84	96
80	20	85	84	97
85	15	84	86	97
90	10	84	88	dry.
95	5	84	89	dry.
100	0	84	90	dry.

MIXTURES OF 50/90 BENZOL AND COMMERCIAL TOLUOL.

50/90	Toluol.	First drop	% at 100° C.	% at 105° C.	% at 110° C.	% at 120° C.
100	0	92°	50	68	80	91
95	5	93	45	64	76	91
90	10	94	33	60	73	90
85	15	94	30	58	73	90
80	20	95	28	57	72	90
75	25	95	26	55	71	90
70	30	96	22	48	67	90
65	35	96	19	47	65	90
60	40	96	15	46	65	90
55	45	97	12	44	65	90
50	50	98	8	42	64	90
45	55	98	4	31	57	90
40	60	99	0	26	56	90
35	65	100	0	25	55	90
30	70	100	0	23	53	90
25	75	100	0	21	53	90
20	80	100	0	16	48	90
15	85	101	0	14	46	90
10	90	102	0	13	45	90
5	95	102	0	10	44	90
0	100	103	0	4	39	90

MIXTURES OF 90% BENZOL WITH COMMERCIAL TOLUOL.

90%	Toluol.	First drop	100° C.	105° C.	110° C.	120° C.
0	100	103°	0	7	50	94
5	95	102	0	21	59	94
10	90	101	0	30	66	91
15	85	100	0	33	68	95
20	80	97	9	48	73	95
25	75	95	16	53	76	95
30	70	95	23	59	78	96
35	65	94	33	60	80	96
40	60	93	43	66	82	96
45	55	92	46	71	85	97
50	50	91	52	72	86	97
55	45	91	58	76	86	97
60	40	91	60	78	88	97
65	35	90	65	81	89	97
70	30	89	71	83	91	97
75	25	88	75	85	91	98
80	20	87	77	87	92	98
85	15	86	83	89	93	98
90	10	85	85	91	94	dry.
95	5	84	88	93	95	dry.
100	0	84	90	94	96	dry.

Thinking it may be interesting to have the distilling points of 90% and 50% benzol, made with pure benzene and pure toluene, I have made the following mixtures with great care, and from materials prepared as pure as it is possible to make them:—

Pure benzene, collected from a large still, crystallised in the Linde ice machine, partly melted and filtered, and again rectified, collecting only the middle portion. It possessed a gravity of ·884, at 15°·5 C., distilled at 80°·5 C. to 81° C., the thermometer falling again to 80°·5 C. near the end of the distillation. When distilled with open steam, the whole came over at a constant temperature of 69° C. (the thermometer in the vapour), the ratio of benzene to water being 16 to 1.

Pure toluene. Prepared in the toluene rectifying apparatus, and re-rectified several times. It had a sp. gr. of ·871 at 15°·5 C., and distilled over at 110°·8 to 111° C. When distilled by open steam the whole came over at 84°·5 C. (thermometer in the vapour), the proportion of toluene to water being 5 to 1.

Pure xylene. Prepared from solvent naphtha on the large scale, and rectified by means of Glinsky's tubes in the laboratory. It came over between 137° C. and 140° C.

The following mixtures were found to produce results as follows:—

Pure benzene	75	50
„ toluene	24	40
„ xylene	1	10
	90% benzol.	50/90 benzol.

and their distilling points for every degree, when distilled in the ordinary manner used for commercial benzols, were as set forth in the table on next page.

Now as to valuation. It is very evident that the old method based on so much per cent., distilling at 120° C., is extremely variable. When benzene, toluene, and the lighter portions of solvent naphtha are equal in price, then, and then only can the method approximate to its real value, but it *never* can be accurate, as crude naphthas

without exception, contain very large and variable percentages of light and heavy hydrocarbons which are removed by treatment with strong vitriol and soda. It is nothing more nor less than a lottery to buy by such a test.

In the second, or improved method, the valuation is simplified, but the B, T, N_1 N_2 and C as proved by their distillation points are not of the quality usually known in commerce, and, moreover, the same fault exists as with the old test—viz., that the test is made upon the unwashed and indefinite article. Thus there is a certain amount of risk, and this must occasion a lower price being offered to the seller to cover that risk.

° C.	90%	50%	° C.	90%	50%
87	First drop.				
88	10		105	94	68
89	18		106	—	70
90	29		107	—	71
91	56	First Drop.	108	95	73
92	70	—	109	—	75
93	71	2	110	95½	78
94	76	11	111	—	79
95	80	22	112	—	82
96	82	29	113	96	83
97	85	34	114	—	84
98	87	43	115	—	86
99	88	46	116	—	87
100	90	50	117	97	88
101	91	55	118	—	89
102	91½	57	119	—	90
103	92½	61	120	98	91
104	93	64	..	..	..

The valuation figures will, of course, depend upon the market prices of the finished articles, though few distillers would be able, without having practically worked many parcels, to say definitely what margin should be allowed between the purchasing and selling prices of the various constituents.

In 1875, when the prices of the finished articles were as follows :—

Benzol, 90%	6/-	f.o.b. Goole, casks free, less 2½% cash in 14 days.
,, 50%	5/-	
Toluol	2/6	
Solvent (N_1)	2/-	
,, (N_2)	1/6	

The values for the analytical products were as follow :—

B	T	N	N_2	C.
4/-	2/6	1/6	1/-	1d.

So that a crude naphtha, such as that alluded to as H B, and worked in the still, would have been worth :—

		d.
B	25×48d. =	1200
T	23×30d. =	690
N_1	32×18d. =	576
N_2	10×12d. =	120
C	10× 1d. =	10
		2596

$$\frac{2596}{100} = 2/2 \text{ per gallon.}$$

To-day the selling prices are—

90%	50%	Toluol	Solvent	Creosote
1/7	1/4	1/2	10d.	no value

and the values of the analytical products :—

B	T	N_1	N_2	C
11d.	8d.	6d.	1d.	nil

making the value of such a crude naphtha to-day, by this method, but 6½d. per gallon.

The figures obtained by my method are absolute and comparable, from whatever part of the country the crude material is derived, the percentage loss, and the heating which takes place on treating with acid gives one a very good idea of the quality of the stuff one has to work, while the distillates represent very faithfully the quantities of benzol and solvent naphtha to be obtained on the large scale. Take, for instance, the H B sample again—by the new test it gave :—

Loss by washing	18½%	
Distillate to 120° C.	45%	
	100°	120°
Test of same	71	94
Distillate to 170° C.	10%	
	126°	160°
Test of same	0	92

The quantities actually obtained from the still were :

90% benzol	23%	
50% ,,	24%	
Solvent	10·4%	
	130°	160°
Test of solvent	1	94

Loss by washing 20%

Knowing this, it would be easy to make an offer for any parcel, with the certainty of knowing that the laboratory results will be produced on the large scale, and the test may be made one in which both buyer and seller could agree upon a sliding scale, the price f.o.b. Goole, or d d in London, being made the basis. Of course, the percentage of the selling prices each manufacturer could afford to give would vary according to circumstances. One with a good pattern of still and a careful rectifier working it, would be able to offer more than one using an old boiler for a still, and injecting steam *ad lib.* into the contents. One may have cheap vitriol for washing, cheap labour, or cheap carriage, which another would not possess, and all these things would have to be taken into consideration.

A rectifier of crude naphthas should be able to say, "I know by the test what I am able to get out of the parcel, and will offer so much per cent. of the selling price, calculated naked at my works, for the 90's, 50's, and solvent contained therein ;" the seller delivering the naphtha to the purchaser's works free, the barrels to be returned free when empty. Some manufacturers are able to do this ; it is for sellers to know it can be done in a satisfactory manner. Now, taking this selfsame crude naphtha again, let us see what money values were obtained from it.

90% benzol	23gals.	at 1/7	f.o.b. Goole casks free, less 2½% cash in 14 days.
50% ,,	24 ,,	at 1/4	
Solvent	10 ,,	at 9d.	

But we must deduct 2d. per gallon for barrels, 2d. for carriage, and 1d. for sundry charges, as leakages, super tares, etc., leaving naked at the works :—

			d.
90% benzol	23gals.	at 1/2 =	322
50% ,,	24 ,,	at 11d. =	264
Solvent	10 ,,	at 4d. =	40
			626

$$\frac{626}{100} = 6\tfrac{1}{4} \text{ per gallon.}$$

Out of which the rectifier will have to find vitriol, soda or lime, wages, steam, repairs, depreciation and other sundry charges, and his profit if there be one.

The present state of things is most unsatisfactory, both for buyer and seller, and if this paper tends to bring about a better state of things it will not have been written in vain.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held November 4, 1885, in the College of Science.

MR. B. S. PROCTOR IN THE CHAIR.

NOTE ON THE COMPOSITION OF GAS FROM MESSRS. ALLHUSEN'S BORINGS AT MIDDLESBROUGH.

BY PROFESSOR P. PHILLIPS BEDSON, D.SC.

THE two samples of gas, the composition of which forms the subject of this short note, were collected from two distinct outbursts of gas which occurred last July during the piercing of the salt at the second of Messrs. Allhusen's borings at Middlesbrough. A similar outburst of gas took place during the piercing of the salt at the first of the borings, the gas issuing from the bore hole in large volumes, shooting into the air, water, mud and debris, to a height of several feet.

For the opportunity of examining these gases and for their collection I am indebted to the kindness of Mr. A. Allhusen.

The gas was collected by placing in the bore hole, at the time of the outburst, an iron tube some 6ft. in length and about 2in. in diameter. This tube was connected by indiarubber tubing with a large glass vessel, such as is used in the construction of aspirators, filled with water. The iron tube was connected with the upper opening of the aspirator, and, by allowing the water to flow out, the gas was drawn in.

The salt was reached at a depth of about 1000ft., and after it had been pierced to a depth of some 82ft., the first outburst of gas occurred. The gas collected proved to have the following volumetric composition :—

Oxygen	1·53
Marsh gas	1·90
Nitrogen	96·57
	100·00

The second outburst occurred at a depth of 106ft., the collected gas having the following volumetric composition :—

Carbon dioxide	0·3
Oxygen	2·9
Nitrogen	96·8
	100·0

From Mr. Hugh Bell's paper, "On the Salt Deposits of Middlesbrough," read before the Cleveland Institution of Engineers in April, 1883, it will be seen that the salt of these deposits contain vessicles, locked up in which is gas, the liberation of which, on the solution of the salt, is frequently productive of slight explosions. This gas is said to consist of nitrogen and oxygen, in the proportion of 94vols. of the former and 6vols. of the latter. The Middlesbrough salt, therefore, resembles certain varieties formed in the Wieliczka deposits, which exhibit similar decrepitations; the gas contained in them being, however, marsh gas only. Further, Mr. Bell mentions in his paper that, during the stoppage of the pumping at Clarence, large volumes of gas bubbled up at the fresh-water inlet of the pumping machinery. This gas proved to contain 97·9vols. of nitrogen and 2·1vols. of marsh gas. Now supposing the oxygen in the gas obtained at the first outburst, to represent air admitted in collecting the gas, the residual gas would contain the following proportions of marsh gas and nitrogen :—

Marsh gas	2·05
Nitrogen	97·95
	100·00

Showing it to be identical in composition with that described by Mr. Bell. If the results of the analysis of the gas obtained at the depth of 106ft., be interpreted in a similar manner, the residual gas would have the following volumetric composition :—

Carbon dioxide	0·4
Nitrogen	99·6
	100·0

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J. Y. Buchanan.	T. L. Patterson.
T. Carnelley.	R. Pullar.
J. Christie.	J. B. Readman.
W. J. Chrystal.	F. J. Rowan.
W. J. A. Donald.	R. R. Tatlock.
J. Ferguson.	W. Wallace.

Hon. Treasurer:
J. J. Coleman, 45, West Nile Street, Glasgow.
Local Secretary:
G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The opening Meeting of the Third Session of this Section was held in the Rooms, 207, Bath Street, on November 3, 1885.

CHAIRMAN'S OPENING ADDRESS.

MR. J. NEILSON CUTHBERTSON said: It has appeared to me, in considering the many subjects that present themselves as suitable for an address, that, in my capacity as a member of the School Board, I might most appropriately refer to the present position of scientific and technical education for the masses of the people. You are probably all aware that four years ago a Royal Commission was issued to inquire into the instruction of the industrial classes in technical and other subjects, with power to take evidence and visit foreign countries. The report of the Royal Commission has been in the hands of the public for more than a year; I have no doubt you have a copy of it in your library, and it must be known to many of you. But, believing the subject to be of such importance that too much attention cannot be given to it, I venture to direct some thoughts to the conclusions of that report. The Commissioners say that they have visited almost every country in Europe, and also in the United States of America; and although they had high expectations of what

they should find there, their expectations were exceeded, and there is no doubt, they say, that many and great advances have taken place in Continental nations in the matter of technical and scientific education. I need only refer you to the most recent development of that education in the splendid university which has been erected at Strasburg. I suppose this new university is expected to take a leading place amongst the universities of Europe. Probably no other university can equal it, with its ninety-two professors, its large number of students, and immense appliances in the way of apparatus and library. We can only hope that that university will have a future in keeping with the splendid preparations that have been made for its success. I might refer, as the Commissioners do, to the great success that has attended Continental science in different ways; in organic chemistry, in the introduction of the ammonia process in the alkali trade, in the ventilation of deep mines, in the application of water power, in the invention of the dynamo machine, in the construction of roofs and bridges, in the printed cottons of Mulhouse, in the woollen yarns of Verviers and in the ribbon trade of Basle. All this is largely due to the greater painstaking, to the greater pliancy and thrift of those concerned, and also to the general acquaintance with modern languages usually possessed by Continental manufacturers.

The reporters go on to say that notwithstanding the great advance that has taken place in these foreign nations, on the whole our people still maintain their position at the head of the industrial world. You must all have been struck with the recent addresses of Sir Lyon Playfair at Aberdeen and Dundee, and how completely he places foreign nations ahead of our own in this matter of scientific education. I am inclined to believe, however—and this report bears me out—that we are not so far behind after all. I think Sir Lyon's words may be taken to mean that we are all right up to a certain point, but require to take care of our hand in time to come. In proof of this position the Commissioners cite the important inventions that have been brought out in this country during the present and the past generations; in fact, they go the length of saying that all the principal machinery that is now at work on the Continent has been derived from England, or, at all events, is the direct offspring of suggestions made in Great Britain. Even in those branches where other nations have hitherto excelled, the reporters are of opinion that we are improving. They maintain—and I hold correctly—that the beginnings of the modern industrial systems are due in the main to Great Britain. Other nations were greatly hindered during the latter part of the eighteenth and the beginning of the nineteenth century by the wars which devastated Continental Europe, and so jealous was the nation at that period and at the close of the great war, that legislative restrictions were imposed which hindered our people from going abroad, and even put a hindrance in the way of exporting machinery to Continental countries.

This was no doubt the occasion of the great efforts put forth by Continental nations to cope with this country, and they began by instituting Polytechnic Schools. These schools are all over the Continent. There is *L'Ecole Centrale* at Paris, and there are the Polytechnic Schools of Germany and Switzerland; and the first step they took was to get men from England and Scotland to start them. After that sprang up the Technical High Schools, for a lower grade of instruction, inaugurated in most of the Continental States. These two grades of schools have been kept mostly at the expense of the different States—I mean the Governments. The result is that everyone who has had to do with Continental manufacturers must have noticed the greater intelligence of their chief men. A Continental manufacturer is generally a man of education himself, and thoroughly up to all the new inventions of the day. He is generally acquainted with several languages, and has thereby the opportunity of studying the periodicals of this country and the literature of the day all over Europe, and of picking out the inventions and appliances most suitable for his own trade. More recently there have been instituted in many of the States Technical or "Industrie-Schulen," intended for boys and young men who wish to become foremen, or otherwise engaged in industrial occupations. The instruction in these schools is similar in character to that of the higher instruction, but inferior in degree. In France they have taken a very large development and are generally treated as higher elementary schools, to which the cleverer boys are passed on after they have completed the curriculum in the ordinary schools. This idea of picking out the cleverer boys is common to the schools in America as well as to those of Continental Europe. They don't bring on the dunces to the higher schools; they examine each scholar after the curriculum has been gone through, and if he can't pass a creditable examination, he is not passed on to the higher school unless at his own expense. Notwithstanding all these efforts, the reporters say that foremen and workmen are not, as a rule, up to the present time, technically instructed, and that they have not—even with all the efforts that have been made—greater advantages than our workmen or foremen have in this country. This class of effort has been chiefly maintained by local effort, and largely by the manufacturers themselves, who seem to be quite aware of the necessity nowadays of scientific instruction, even amongst their men, at all events amongst their foremen, and they spare no pains to have them educated. Nothing, however, that they have yet been able to achieve is equal to the instruction that we have in this country through the schemes of the Science and Art Department and the City and Guilds of London Institute.

In two respects scientific education abroad seems to excel what we have at home. First, as regards *drawing*; and second, as regards *general elementary education*. In France and Belgium an effort is made to have every child instructed in drawing; and in regard to the United States, the Commissioners consider the great feature of technical instruction there is the superior general education, which the mass of the community receive in the elementary schools.

I need not say that this latter deficit will not much longer exist, for I maintain that the mass of our people, by another generation at all events, will be as well, if not better educated than their American cousins.

Now, to bring home these remarks to our own country, the reporters wish to point out the need we have of technical instruction, especially for foremen and artisans. The time was when it was supposed that instruction of that kind had better be reserved for the head of the house, with one or two assistants in the laboratory, but I hope that day is at an end. We have now our mechanics' institutions blossoming into colleges of science and arts. We have evening classes everywhere for science of a kind. I don't pretend for a moment that the science thus to be had is of the very highest level; at all events it goes so far as to accustom young people to elementary ideas regarding science, and to bring out (which I think is a great point) those who have the aptitude and abilities for following out the higher studies. In proof of this, I may cite the opinion of a gentleman well known to you all, who was called upon to examine a school in elementary science. I said to

him, "Now, do you think that what you have seen there is likely to interfere with your own professional work?" "Not at all," he said; "I believe that all that anyone can do in that direction will only be a feeder to the higher institutions." I think if this view be taken, you will find in future a much larger number of boys who would be desirous to have higher scientific instruction. They point also to the examples of special schools. I am not acquainted with the lace trade in Nottingham, but from the report it seems that Nottingham has been largely benefited by an art school there, and the lace trade which had been languishing has got a new impetus; and it is known to us that the Lambeth School of Art has been the means of raising the Doulton pottery to a higher position than it might otherwise have attained. I need scarcely mention to you, gentlemen, the City and Guilds of London Institute. There we have an effort put forth by the Guilds of London, who are possessed of immense wealth, and who of late years have been looking about to make a good use of it, lest it should be taken from them in another way; and we must certainly approve of what they have been doing. All over the country they hold examinations which have been the means of bringing forward a continually increasing number of candidates. Their rewards are of a very substantial kind, including medals and money rewards; and I have no doubt many working men have been brought out who otherwise would have remained unnoticed. The universities, too—to ascend to a higher platform—now give a much larger modicum of natural science than formerly, and I am quite sure professors of science in universities will cordially welcome any movement in that direction. Indeed, I may say that throughout the whole community there is a growing desire, and especially amongst educational bodies to promote scientific and technical education; and a desire, above all things, to know how it can be best accomplished.

The reporters are of opinion—and I dare say we all agree with them—that the foreign systems are not exactly applicable to this country. There is a kind of autocratic fragrance about them, that could not rightly be transplanted into British soil, and we must look at home for something of a more natural and easy growth. With the exception of France, where the recent educational revival has assumed enormous proportions, the British Government is now spending a larger sum of money than any Government in Europe upon its education, and all that is needed is to see that it be properly and wisely dispensed.

In a general way it may be taken for granted that men of leisure and means have no difficulty in this country in getting scientific education. I may perhaps differ with Sir Lyon Playfair as to this point, for, as far as I remember, in Glasgow there never has been a time that there was not good scientific education. In fact, I have been often astonished to hear people from a distance speak of the difficulty of getting instruction in chemistry. In all my recollection there have always been schools of chemistry in Glasgow, still increasing in usefulness and popularity, so that people of very moderate means have hitherto had no difficulty in getting scientific education. The best preparation, the Commissioners remark, for studies of that kind, is a good system of secondary schools, and they point above all others to the Manchester Grammar School, as a school which has of late years been brought up to a high point of efficiency, and which they recommend as an example to others. I hope that in Glasgow we shall be able, with the assistance of the Endowments Commission and of other local authorities, to have abundance of scientific instruction of that higher grade. But that is not quite the point at which the Technical Commission has been aiming. It is rather how are the great mass of the working population to be instructed in elementary science. There can be no doubt that that ought to be begun in the primary schools. The Commissioners consider that if general ideas of science be given to children of ten, eleven, or twelve years of age (as I stated at the earlier part of my remarks), this will prove to be seed sown in the minds of boys, which will bear fruit in the form of a hunger for greater information; and they think this should be done by special teachers, or by visiting masters, as has been done in Liverpool and Birmingham—going round the schools on certain days of the week giving lessons in elementary science—and then the scholars so initiated should be led up to higher schools or classes, either day or evening. This sort of work involves a set of apparatus, which, of course, must be supplied from some public source. They seem to think that the School Boards would not be able to overtake that, but I have yet to learn that the Scotch Act of 1872 does not include this to such moderate extent as may be required. They also recommend the institution of industrial museums and loan collections, and that all these should be largely promoted by employers and manufacturers. There is no doubt, as I have already said, that what is being done in that connection on the Continent is promoted by employers of labour more than by the Government; and I feel quite sure that great employers of labour in this neighbourhood need only to have their attention called to this matter to be willing to encourage such scientific education among the people whom they employ. It is also recommended that manual work should be introduced into the public schools. Regarding this there may be differences of opinion. It has been done very successfully in Allan Glen's School, in the City of Glasgow, and in the Buchanan Institution, and in some towns in England. The reporters give a list of all the different institutions and colleges they have visited, and while not willing to differentiate between one and another, they are anxious to believe that all are doing good work, and only require greater encouragement and greater support in the way of funds, to do a much better work. They make again and again reference to the technical examinations of the City and Guilds of London Institute. I know scientific men are apt to pooh-pooh this sort of thing, but what I say is that in the absence of anything better we are very glad to have it, and if it be but the beginning of a better state of things we shall have good cause to thank them and to hope that they may continue to prosecute their labours.

At the close of their report the Commissioners make one or two suggestions. In the first place they suggest that in the public schools drawing should be incorporated as a class subject. Drawing does not so much concern us as a society, but still it seems to be applicable to most branches of scientific study, and one good effect the publication of this report has had is, that now the Education Department have issued instructions that drawing shall be taught to every child—boy and girl—and no doubt this will result in much good. They express their own opinion that boys especially should be taught to use tools in wood and iron, and that this should be made a "specific subject" in the education code. They also suggest that the provision which is now operative in Scotland, to prevent a boy or girl under 14 years of age from being employed full time, unless they have passed the fifth standard, should be extended to England. As to classes in connection with the science and art department they consider that the local authorities, school boards, or others,

should be empowered to establish such classes. Now in Glasgow we consider we have power to establish such classes, and I hope that before the expiry of the present School Board we shall have nine well filled art schools, with drawing room perhaps unsurpassed by any in the kingdom, and that we shall also have six or eight schools where elementary science is taught with proper apparatus. They suggest that the inspection of such classes ought to be rendered more effective, and that contributions should be made by the authorities at head quarters to local museums, or in some other public way. They are of opinion, as already explained, that a great deal is to be expected from employers of labour and trade organisations. They hope to see the day when it shall be necessary for a boy, before entering on an occupation where science is required, to undergo some preparation in elementary science; and when the managers and promoters of such classes shall place the teachers in a position to carry their boys into higher stages, either by having scholarships introduced, or by some other means.

Now, gentlemen, if you want to get a good crop of scientific men, at all events men intelligent as to the elementary science, you must begin at the lowest stage; not give a boy or girl too much to understand or study, but give them broad general ideas, which shall enable them afterwards to appreciate the higher instruction which many distinguished men in this city and elsewhere are prepared to give.

FURTHER NOTES ON A NEW SYSTEM OF COOLING OILS FOR THE EXTRACTION OF PARAFFIN.

BY GEORGE BEILBY.

At one of the meetings of this section last session I described a new system of cooling oils for the extraction of paraffin (*Journal*, iv. 321). At that date apparatus on the full manufacturing scale had just been completed at Oakbank Works. It has occurred to me that some of the members may be interested to hear the results of the summer's work with the new plant.

June, July, and August have always been trying months in the freezing houses of paraffin works. Freezing plant, which, for the colder months of the year, is of ample power, may, in the summer months prove quite insufficient. This loss of efficiency necessitates one of two courses, either that a large percentage of paraffin must be allowed to escape in the oils, or that the imperfectly frozen oils must be kept in stock till the colder months to be then refrozen; under either alternative heavy loss is entailed.

The new system was designed to meet and overcome two manufacturing difficulties. The first of which has been referred to, namely, the loss of cooling efficiency during the summer months. The second difficulty is the imperfect separation of paraffin from oils, which results from too rapid freezing, whereby the paraffin is separated in an imperfectly crystalline state, and this amorphous or semi-crystalline paraffin is not only difficult to filter from the bulk of the solvent oil, but the pressed cakes of paraffin scale are apt to retain an excessive percentage of oil. How far the new system has overcome these difficulties will be shown by an examination of the results of the past six months' working.

The Temperature of the Cooling House.

The apparatus and the structure of the house were originally calculated and designed for the maintenance of the air inside, summer and winter, at a temperature of 32° F.

The cooling house is 56 feet long, 48 feet broad, and 25 feet high, its cubic capacity is therefore 67,200 cubic feet, and, after deducting the volume of the contained apparatus, the actual air space within the house is 58,900 cubic feet.

The internal wall surface is 5200 square feet, the roof and floor surface 5376 square feet, or a total internal surface of 10,576 square feet. The cooling of the air of the house is effected by the exposed surfaces of the ends of the brine cells amounting on an average to 1600 square feet at a mean temperature of about 20° F.

The refrigerator is one of Pontifex and Wood's ammonia machines with a nominal ice-making capacity of 9 tons per 24 hours.

During the months of June, July, and August, though the apparatus was in pretty full work, there still remained many details to be adjusted, but the general cooling results were very satisfactory. For the week ending the 25th July the following were the readings of thermometers inside and outside the house:—

	Outside Thermometer on North Wall.	Inside Thermometer 5ft. from floor in centre of House.
20 July, at 1 p.m.	62°	31°·5
21 ,, ,,	60	30·5
22 ,, ,,	62	30·0
23 ,, ,,	72	32·0
24 ,, ,,	71	32·0
25 ,, ,,	79	34

During this week one of the ammonia pumps was off for repair, so that the refrigerator was worked at about one half of its full power. As a rule it is not necessary to work the refrigerator on Sunday as the temperature inside the house only rises about 1° between Saturday and Monday. As the details of the plant were gradually perfected the results showed a corresponding improvement. For the week ending are the readings of the thermometer inside and outside:—

	Outside Thermometer on North Wall.	Inside Thermometer, 5ft from floor in centre of House.
14 September, at 3 p.m.	56°	28°
15 ,, ,,	62	29
16 ,, ,,	58	29
17 ,, ,,	58	29
18 ,, ,,	60	28
19 ,, ,,	56	28

The refrigerator was doing about half work during this week, as we have found that 27° or 28° is a sufficiently low temperature for the air of the house—at lower temperatures the oil filters sluggishly.

The lowest temperature ever observed on the inside thermometer was 26°, and the greatest difference between the outside and inside thermometers was 45°. Of course, the temperatures on the south and west walls, in the direct rays of the sun, must often have reached 90° to 100°, giving a difference of 65° between the outside and inside.

It was at first feared that the workmen might suffer from the sharp contrast between a summer temperature outside and a winter temperature inside the house; but, apart from an occasional cold, no bad effects have been traced to this cause.

Cooling of the Oil and Paraffin.

In connection with my former paper, a diagram was exhibited (*Journal*, iv. 324), on which were laid down the curves of cooling of a mass of oil and paraffin as determined in an experimental cell of the standard width, 12 inches. These curves showed that, with air of a mean temperature of 20° F. as the cooling medium, the mass of paraffin in the cell was reduced to a mean temperature of 30° in ninety-six hours. In practical working, it is found, with brine

at 10° F. as the cooling medium, that the mass of oil and paraffin in a cell 16′ × 8′ 6″ × 12″ wide is reduced from 100° F. to a mean temperature of 24° in from seventy to seventy-five hours. At this rate of cooling the crystallisation of the paraffin is very satisfactory.

Manipulation of the Cooled Oil.

No difficulty has been experienced in emptying the cells by means of the screw at the bottom of each. When the screw is rotated the block or slab of cooled oil invariably slips down as its base is sheared away, no manual or other assistance being required.

Owing to the great stiffness of the cooled paraffin, even after it has been mashed by the screw and delivered through the valve at the end of the cell, considerable difficulty was experienced in getting the filter press-pumps to draw and force the mass into the filter frames. After contending with this difficulty for some weeks, it was eventually found necessary to abandon the close collecting pipes from the cells to the pumps, replacing them by open wooden troughs. Since this alteration has been carried out the working has fallen into the regular system for which it was planned, so that one of the four blocks (of ten cells each) is emptied and refilled every day.

Owing to the perfect crystallisation of the paraffin, the separation of the oil is much facilitated, so that filter presses which, under the old system of "drum cooling," took ten, eighteen, and even twenty-four hours to fill up, are now filled regularly every three hours.

In the following table the old and new systems of paraffin cooling are contrasted in the records of working under each when the conditions of outside temperature were identical :—

	1884. Old System.	1885. New System.
Outside Thermometer on north wall ..	60° F.	60° F.
Inside „ 5 feet from floor	56	28
Oil from coolers	18	24
„ filter presses	11	25

The old system is imperfect in two important particulars ; in the first place, the too-rapid cooling produces a paraffin which will not separate freely from the oil, and in the second place, the cooled oil itself is the only medium by which the temperature of the apparatus is reduced and kept down ; consequently, the oil and paraffin has to be cooled to a temperature much below that at which the filtration actually takes place.

The figures given above show that under the old system the oil was cooled 26° below the temperature at which filtration actually took place, while, under the new system, the difference is only 1°. The above figures are not put forward to show the best results obtainable under the old system, but merely to illustrate the distinct principles on which the systems are worked.

Quantity and Quality of the Paraffin.

The gain of paraffin by the new system is about 25 per cent., so that a crude oil, which yielded under the old system 10 per cent., now yields 12½ per cent. of paraffin. This on the present through put at Oakbank Works is equal to 180 tons of paraffin a year, valued at £4500.

This gain of paraffin is not alone due to the low temperature of extraction, but to a considerable extent results from other modification of the refining process which have been rendered possible by the system of slow cooling and crystallisation.

The average melting point of the paraffin scale extracted by the new process is 112° F., or a fall of about 6° as compared with the old process. The scale on refining gives :—

74 per cent. of wax, melting point 120° F.
11 „ „ „ scale, „ „ 90° F.
15 „ „ „ oil and unrecovered soft scale.

It is now possible to produce commercially-soft paraffin of any melting point, from 80° F. and upwards. Hitherto most of the low melting paraffin made in Scotland has been used for dipping wooden matches, but the quantity at present being produced is likely to be far in excess of the requirement of the match trade. It is much to be desired that new outlets should be found for it, and it is to be hoped that one good effect of the present low price (1d. to 1½d. per pound) will be to extend its consumption. It is said that soft paraffin is being used to adulterate tallow ; fortunately, as an adulterant, it will be detected with great ease, but it seems not improbable that the mixture of soft paraffin with tallow and lard may be found to improve both for many purposes.

Working Costs.

Twelve men at an average wage of 3s. 6d. per day can turn out 26 tons of paraffin scale per week, equal to a cost of 10s. 6d. per ton. To this must be added the wages of enginemen and foreman, making a total of say, 15s. per ton. When the output can be increased to 50 tons per week, the cost for labour will be reduced to about 12s. per ton.

Owing to the small size of the refrigerator for the very large amount of actual cooling done, the cost under this head is necessarily very moderate.

An important item of paraffin house expenditure is for sheeting and filter cloth. Trustworthy statistics of the saving under this head are not obtainable yet, but there is no doubt that the saving will be considerable, as the well-crystallised paraffin separates freely both in filter-presses and hydraulic-presses.

DISCUSSION.

Mr. Coleman said : This paper by Mr. Beilby is a continuation of a paper which he read last session, and in which he described a method of cooling and filtering and pressing paraffin oil in chambers which are insulated. As to the mechanical arrangements which Mr. Beilby has adopted for the transference of the crystals of cooled paraffin to the filter presses, it shows, as I have already said, great ingenuity. This kind of screw prevents the handling of the material, which is so prejudicial to bringing up the crystals. They are more easily transferred without being crushed or broken, and consequently, the produce of wax is increased. In reference to the process itself, being conducted within insulated walls, it is no doubt a most excellent thing to do, and it surprises me that the paraffin oil people have not had the sense to adopt some such method earlier. It must be obvious that to cool a substance down near freezing point, and then filter and press it in a warm atmosphere, is a most ridiculous proceeding, and in many circumstances the cooling is a most expensive operation. One of our townsmen—Mr. W. Walls—is noted for his sperm oil. He had five years ago another machine which he used for cooling sperm oil, and it struck him that there must be immense waste in the oil being manipulated, after cooling, in the ordinary warm air of his workshop. He consulted me as to whether I could not design a cold chamber, in which the process might be carried on. I designed one, and since that time his production of spermaceti has been considerably increased, and the quality of his oil has been improved.

Professor Mills said : In common with many others who have visited a paraffin oil works, I have been very much struck with the absence of air-cooling

in the department where the scale is frozen and pressed. I am very glad that Mr. Beilby has not only introduced it, but succeeded in making it pay. The increase of 2½ per cent. must be chiefly in soft scale. Paraffin of this kind would have been, years ago, exceedingly valuable to the late Dr. Stenhouse, with whom I was associated in his early experiments on the waterproofing of cloth. At that time we required a paraffin of extreme qualities, some very hard and some very soft. Paraffin similar to this specimen would have suited us admirably, and would have made a capital waterproofing agent. As we had not paraffin of this description we were obliged to take hard paraffin and mix it with olive oil, so that when the waterproofing agent was introduced into the tissue—for example, boot leather—the crystals of scale would not produce friction. It struck me that this particular paraffin, this new soft scale, would have been the very thing for waterproofing cloth, inasmuch as it would yield to every movement of the wearer. I am sure this contribution to the technology of the subject is one of material interest and importance, and I hope Mr. Beilby will succeed in increasing the sale of soft scale.

HIGH TEMPERATURE THERMOMETERS.

BY JAMES MURRIE.

Since reading the paper on a new series of thermometers before this section of the Society last session, a few modifications have been made for the purpose of indicating very high temperatures, a description of which may prove interesting.

The principles embodied in the construction of the apparatus have been already explained (*Journal*, iv. 45, 189). The essential feature consists in the raising of the boiling point of a liquid by pressure, the liquid being confined in an expansion chamber, which forms one end of a hollow tube, the opposite end of the hollow tube being practically sealed by means of a pressure indicator. On taking indications of temperature, the expansion chamber is subjected to the action of the heat; the confined fluid in consequence expands, and in the act of expanding tends to compress the liquids placed in the hollow stem intermediate to the expansion chamber and the pressure indicator; the indicator being graduated to show the corresponding temperature.

For indicating low temperatures, a fluid of comparative volatility may be employed. For temperature above 400° Fahr., mercury has been found suitable, the upward limit of an instrument for continuously indicating the temperatures being 1700° Fahr. Above this point the metal becomes too plastic and porous to contain the vapour.

For continuously indicating temperatures above 1700° Fahr., the apparatus is not adapted, although it can be modified to enable indications being taken at intervals, the maximum range being about 4000° Fahr. The expansion chamber is enveloped in a conducting body, and attached to, or forming part of, the indicator is a time recorder. On the expansion chamber with its coating being brought in contact with the heating body, the mercury in the expansion chamber is slowly heated, depending more particularly on the intensity of the heat surrounding said casing. The indicator registers the degree of heat, and a chronograph records the time taken to raise the temperature of the mercury between two predetermined points. It is, of course, necessary to withdraw the instrument from the action of the heat before the temperature of the mercury is sufficiently raised to create a pressure which would destroy the instrument.

For very high temperatures, more particularly when the heated body is in a gaseous form, the difficulty is in obtaining a sufficient volume of gas at a nearly uniform temperature. Above 3000° Fahr., the temperature is rarely constant for any period at a fixed point, and in consequence the indications obtained by means of the apparatus cannot be taken at the maximum temperature existing in the furnace or oven. When the heated body is in a liquid form, and the chamber completely immersed in the metal, the temperature can be better determined.

For temperatures under 1700° F., the main difficulty experienced has been in preventing leakage of the confined fluids, a very slight leakage having the effect of emptying the chambers of their contents.

This difficulty, however, might possibly be lessened, if not overcome, with the result that the duration of immersion would not materially affect the accuracy of the register of temperature. In stating this I understand that a London scientist has given expression to different views from those I have embodied; but I have seen nothing to shake my convictions as to the accuracy of my conclusions in the matter.

In answer to various questions, Mr. Murrie said: The only liquefied gas which has been tried in the thermometer is liquid carbonic anhydride. It is at present very difficult to reduce hydrogen, nitrogen and other gases, to the liquid state; but I am at present engaged in a new process for liquefying gases rapidly and with facility, which at present I am not at liberty to describe. In the case where liquefied gases are employed, the inner chamber is, by means of a tube with a stop cock, connected with a generator in which the gas is liquefied, and from which the chamber is charged. The highest temperature at which these liquefied gases can be used depends on the pressure of the saturated vapour. Some of these vapours have so great a pressure at ordinary temperatures that it would be impossible to retain them in such an apparatus; but liquefied carbonic anhydride, for example, could be kept in the thermometer, say, to the temperature of boiling water. To take the temperature of a small blast furnace, it would have to be so constructed that the chamber of the thermometer, when inserted, would be surrounded by some comparatively non-conducting material. Thus, the mercury chamber would be surrounded with clay, through which heat passes very slowly. The mercury becomes heated at a corresponding rate, and the time taken to heat the mercury, say, to 1500° F., is noted on a chronometer, and the temperature calculated from this.

Nottingham Section.

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R. Fitzhugh.	

Hon. Local Secretary:

J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The opening Meeting of the First Session of this Section was held in the Laboratory of the Basford Station of the Nottingham Corporation Gas Committee, on Saturday, November 14, 1885.

ON THE ANALYSIS OF GAS COAL.

BY LEWIS T. WRIGHT, F.C.S., ASSOC. MEMB. I.C.E.

COAL analysis as understood by a gas-maker refers principally to two important factors—viz., the volume of gas a coal is capable of producing, and its luminosity under the conditions of his manufacture. Of course there are several other points, such as quantity and quality of coke, tar and ammoniacal liquor, sulphur, ash, etc., which must engage his attention; but the first question he naturally asks in reference to a new coal is, What quantity of gas will it produce, and of what candle-power? A correct knowledge of the capabilities of a coal is of double importance to us as gas manufacturers. In the first place we can assign to it a pecuniary value, and in the second place we are, by a knowledge of the various coals we employ, enabled to better supervise and control our operations, and determine our manufacturing losses—if any.

In the present paper I propose to consider the various methods of analysis, and, to some extent, by comparison, to discuss their relative merits, and finally to compare the results of the most approved method with actual manufacturing experience.

For the examination of a coal from a gas-maker's particular point of view, there are several means—(1.) To make a proximate analysis, and thereby discover how much moisture, volatile matter, coke, ash, and sulphur the coal contains. (2.) To make a practical analysis of the coal by distilling it (*a*) either in a small iron retort with other necessary apparatus for collecting the gas and measuring its volume, etc.; or (*b*) in a setting of clay retorts as used in modern gas manufacture, with other necessary plant for exhausting, condensing, scrubbing, purifying, measuring the gas, and collecting and measuring the liquid products and coke, just on the same lines as we operate in gas manufacture. There is another method—viz., elementary analysis, perhaps of more interest to a chemist than to practical people, but which should not be neglected if a complete knowledge of the coal is required.

Elementary Analysis I will not enter into, as it is fully treated on in the best text books, such as Fresenius', etc., but merely mention that the oxidising material preferred is lead chromate.

Proximate Analysis.—Proximate analysis may be said to consist of the following determinations:—Moisture lost at some given temperature; volatile matter; fixed carbon; ash; sulphur.

The first determination is that of moisture, and at once plunges us into doubt. At what temperature shall the sample be dried? It being known that coal does not lose all its moisture at 100° C., some recommend drying at higher temperatures than that of boiling water. Hinrichs says, put down as moisture the loss in weight of finely-pulverised coal after drying for one hour at a temperature between 105° and 110° C. Fresenius recommends 110° C.; but coal dried at 110° C. will lose more water if further dried at 150° C., and so on. So it does not appear that a temperature of 110° C. has any special recommendation in respect of obtaining all the moisture. Since 100° C. is a temperature easily secured and maintained constant by means of a water-bath, I have adopted it as a standard.

The usually adopted rule of estimating moisture by loss of weight in drying at a given temperature, is to proceed with the drying until the weight of the substance becomes constant. This procedure is not free from error. In the first place, the loss of weight by drying at about 100° C. for any given time does not equal the actual amount of water evolved. In the second place, if most samples of coal be examined by the drying method of weighing at certain intervals of time, it will be found that after a time the samples not only cease to lose weight, but actually gain. This gain has been noticed by different observers. Hinrichs attributes the increase to the slow oxidation of some matters in the coal (pyrites, etc.); but this is a subject deserving of independent investigation, and will perhaps be found to be due to the absorption of gases into the pores of the coals left vacant by the expelled moisture. It is reasonable to suppose that the increase of weight which only exhibits itself after a large portion of the moisture has been got rid of, has really been taking place during the whole period of the drying process. In that case the water actually lost will be more than is shown by loss in weight, and this I have always found. Some experiments with coals of different character will exhibit this:—

Scotch splint, finely powdered, dried 1½ hours in an atmosphere of coal gas—		
Moisture lost at 100° C., weighed as water in a drying-tube	(*a*)	10·22 per cent.
Moisture estimated by loss of weight in drying the coal at 100° C.	(*b*)	9·66 ,,
Another experiment given for the two methods	(*a*)	10·31 ,,
	(*b*)	9·76 ,,
Durham gas-coal	(*a*)	1·79 ,,
	(*b*)	1·59 ,,
Welsh cannel	(*a*)	4·74 ,,
	(*b*)	4·36 ,,

The difference between the two methods may be taken to represent the increase in weight during the drying process, and may be tabulated as follows:—

Scotch splint, first experiment	0·56 per cent.
Do. do., second experiment	0·55 ,,
Welsh cannel	0·38 ,,
Durham gas-coal	0·20 ,,

From which it might be concluded that the increase in weight varies in some direct proportion with the moisture.

It will therefore be seen that the ordinary method of determining the moisture in coal by loss of weight in drying is not satisfactory, and that where accuracy is required, the water must be actually weighed as such. In any case I would suggest 100° C. as the drying temperature. The determination of volatile matter will be found even less satisfactory than the foregoing determination, until some standard method, however arbitrary it may be, has been adopted by all operators. Professor Hinrichs states that the total volatile matter of coal is determined with accuracy (1 milligram on 1grm. of coal) by taking 1 to 2grm. of undried pulverised coal, heating for 3½ minutes over a Bunsen burner (bright red heat), and then immediately, without cooling, for the same length of time over a blast gas-lamp (white heat); and he has published some experiments in support of his conclusion, from which the following series is quoted:—

Weight of Coal.	Volatile Matter. Per cent.	Deviation.
1·910grm.	49·58	−0·18
1·147 ,,	49·87	+0·11
1·031 ,,	49·85	+0·09
Average	49·76	
Greatest difference		0·29

Adopting the above method of Hinrichs, I obtained, by exercising extreme care, the following

results with two different samples of undried powdered coal—

DEAN'S PRIMROSE GAS-COAL.

(This coal has been exposed to the atmosphere in a finely powdered state for two years.)

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.
2·018grm.	31·22	−0·28
2·014 ,,	31·62	+0·12
2·009 ,,	31·66	+0·16
Average	31·50	
Greatest difference		0·44

SILKSTONE GAS-COAL.

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.
2·059grm.	41·57	+0·28
2·022 ,,	40·90	−0·39
2·005 ,,	41·39	+0·10
Average	41·29	
Greatest difference		0·67

The above experiments are not selected, but were consecutive, and though not so promising as those published by Hinrichs, they are fairly comparable.

The following experiments were made by myself. The method of operation was to weigh the coal in a thin platinum crucible without the cover, which was only used during the heating and cooling in the desiccator. The reason for not weighing the cover was that it becomes coated on the inside with a thick deposit of soot, which clearly belongs to the volatile matter. The inside of the crucible also acquires a thin carbonaceous deposit (in some of the experiments allowed for); but the error due to this deposit is small compared with those due to different systems of heating. However, it always tends to make the volatile matter too low. In these experiments volatile matter includes all moisture.

1. Experiments with Scotch splint coal (moisture 10·26 per cent.). Gas flame 600mm. long, 100mm. diameter; coal in small lumps; flame applied until all appearances of gases ceased issuing from under lid of crucible :—

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.
4·768grm.	41·69	−1·11
4·583 ,,	43·16	+0·36
4·472 ,,	43·96	+1·16
3·911 ,,	42·10	−0·40
Average	42·80	
Greatest difference		2·27

2. Coal finally powdered, all other conditions as in above series :—

Weight of Coal.	Carbon Deposit on Crucible.	Volatile Matter. Per Cent.	Volatile Matter corrected for Carbon. Per Cent.	Time. m. s.
1·110grm.	0·008	43·25	43·60	1 30
1·551 ,,	—	44·61	—	1 45
2·672 ,,	0·004	43·48	43·64	2 35
3·600 ,,	—	43·27	43·55	3 30
3·878 ,,	—	42·13	—	3 45
4·939 ,,	—	42·70	42·80	4 30
Average		43·24		
Greatest difference				2·48

This method of heating till all appearances of gases cease issuing from the crucible, has not been found satisfactory. The experiments with powdered coal appear least so; but against this view might be urged the greater difference in the weights of coal taken for each experiment.

3. Welsh cannel (moisture 4·74 per cent.). Gas-flame as before, but heating continued for a constant period of 90 seconds :—

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.
2·005grm.	49·17	+0·39
2·080 ,,	48·79	+0·01
2·072 ,,	48·26	−0·52
2·024 ,,	48·91	+0·13
Average	48·78	
Greatest difference		0·91

4. Silkstone gas coal (moisture 7·75 per cent.). Same conditions as in series No. 2, with the exception of varying power of gas-flame—

Volatile Matter. Per cent.	Length of Gas-Flame.
41·35	600mm.
40·23	300 ,,
39·93	200 ,,
39·48	100 ,,

These experiments show fairly well the differences due to the power of the gas-flame.

5. A method was tried of heating until the gases ceased, and then heating for a further period of 1 minute. Gas-flame 600mm. long, 100mm. diameter; coal powdered :—

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.	Time Gases Ceased. m. s.	Total Time. m. s.
1·187grm.	40·69	+0·01	1 0	2 0
1·463 ,,	40·53	−0·12	1 15	2 15
3·142 ,,	40·70	+0·05	2 30	3 30
4·150 ,,	40·70	+0·05	3 20	4 20
Average	40·65			
Greatest difference		0·17		

These results were thought to be sufficiently good, and the method was afterwards tried with various samples of coal.

6. Dean's primrose gas coal (fresh). Conditions the same as in series No. 5 :—

Weight of Coal.	Volatile Matter. Percent.	Deviation.	Time Gases ceased. m. s.	Total Time. m. s.
2·024grm.	33·59	+ 0·01	1 40	2 40
2·066 ,,	33·51	− 0·06	1 50	2 50
2·130 ,,	33·66	+ 0·06	1 55	2 55
Average	33·60			
Greatest difference		0·12		

7. The same powdered sample of coal was tried after two years' exposure to air. Gas-flame 600mm. long, 100mm. diameter :—

Weight of Coal.	Volatile Matter. Per Cent.	Deviation.	Time Gases ceased. m. s.	Total Time. m. s.
(1) 2·030grm.	30·88	+ 0·02	2 10	2 40
(2) 2·113 ,,	31·04	+ 0·18	2 15	2 50
(3) 2·005 ,,	30·67	− 0·19	2 40	3 20
Average	30·86			
Greatest difference		0·37		

The time required to expel the gases in these three experiments discloses an apparent anomaly which requires explanation. In all experiments it had been the practice to maintain the coal-dust as an even layer on the bottom of the crucible, and to keep the crucible in an upright position during the heating. The ring which was used in this series (7) being small, caused the crucible to cant over, and shifted the coal-dust into a little heap in the corner. This heap being thicker in the centre than it would have been if spread evenly over the bottom of the crucible, was less favourably disposed for quick heating. This explanation of the apparent anomaly was verified by an examination of the coke residue. Trifling as this point may appear, it should have attention in accurate experiments.

8. West Leverson coal. Same conditions as in No. 6 :—

Weight of Coal.	Volatile Matter. Per Cent.	Time Gases ceased. m. s.	Total Time. m. s.
2·081grm.	32·39	1 50	2 50
2·113 ,,	32·18	2 10	3 10
Average	32·28		
Difference	0·21		

9. Leverson coal. Same conditions as in No. 8 :—

Weight of Coal.	Volatile Matter. Per Cent.	Time Gases ceased. m. s.	Total Time. m. s.
2·153grm.	33·12	1 55	2 55
2·065 ,,	33·02	1 50	2 50
Average	33·07		
Difference	0·1		

10. Felling Main coal. Same conditions as in No. 8:—

Weight of Coal.	Volatile Matter. Per Cent.	Time Gases ceased. m. s.	Total Time. m. s.
2·205grm.	32·88	2 0	3 0
2·211 „	31·80	2 0	3 0
Average	32·31		
Difference	1·08		

11. Australian shale. Same conditions as in No. 8:—

Weight of Coal.	Volatile Matter Per Cent.	Time Gases ceased. m. s.	Total Time. m. s.
2·009grm.	78·69	1 20	2 20
2·017 „	78·58	1 25	2 25
2·019 „	78·55	1 26	2 26
Average	78·61		
Greatest Difference	0·11		

Series 5, 6, 8, 9, 10, and 11 were all conducted in the same manner, and with the exception of No. 10 were very satisfactory. For want of a better method I have adopted the following:—Take about 2grm. of finely pulverised coal, and let it form an even layer on the bottom of a thin platinum crucible. Weigh without cover, place the crucible (with cover on) in an upright position on an iron ring, round which has been wound sufficient platinum wire to prevent contact between the iron and the platinum crucible. Then apply a powerful gas-flame (to secure even results endeavour to keep the same length of flame in all experiments). Note when the gases cease issuing from under the lid; allow one minute further heating; remove the gas-flame, place the crucible and cover in a desiccator for about five minutes to cool, and then weigh without cover as soon as possible.

It is extremely difficult to get fair samples of cannel coal, there often being several layers within a few inches of widely different quality. The following case is quoted:—A piece of curly cannel was taken, 6 inches deep, and on examination it was found that it consisted of various thin layers without any very sharp definition, but gradually merging together. The different appearances of the layers and the volatile matter are as follows:—

Very bright black curly	78·8 per cent.
	76·0 „
	79·4 „
Shiny curly	76·3 „
Dull curly	69·5 „
Smooth	61·7 „

The determination of ash is one that admits of great accuracy, if performed with due care. The very common mode of operating in platinum boats or dishes, placed on an open flame, is subject to a serious error, due to draughts carrying away some of the very fine and light particles of ash. Cannel and easily incinerated cokes may be treated in a deep platinum crucible; but very refractory cokes and such substances as gas carbon require a different method.

Weigh about 2grm. of the coal or coke in a piece of platinum foil, rolled so as to admit of its easy passage into a piece of combustion-tubing of about 1in. diameter, and heat to redness, whilst a very gentle current of air is being drawn through the combustion-tube by means of an aspirator. Working in this way, a beautifully clean ash can be obtained in a very short time; but it is necessary to guard against using a heat that would cause the foil to fuse to the glass. It is well to know that coke absorbs moisture very rapidly. For this reason it is best to take a separate portion of coal for the ash determinations, and not to weigh a portion of the coke obtained in the volatile matter determination. The ash should be saved for the further determination of the sulphuric acid therein.

For the determination of total sulphur there have been suggested innumerable methods, such as fusion with alkali and alkaline carbonates and nitre; boiling with hydrochloric or nitric acid and chlorate of potash; aqua regia; fuming nitric acid under pressure in sealed tubes; combustion with calcic hydrate, etc.; but, in my opinion, by far the best and simplest method is that of Nakamura, which is thus described:—

It consists in heating the coal below a red heat in contact with alkaline carbonates, by which the coal, whether bituminous or not, rapidly undergoes, without evolution of smoke, complete atmospheric oxidation in a manner hardly to have been expected. The details of the method are as follow:—Take 3 or 4 parts of the mixed alkali carbonates, or of sodium carbonate, to 1 part of coal in very fine powder. Intimately mix in a large platinum dish or crucible with a dry glass rod, and heat the mixture in the dish or crucible loosely covered, at first so gently as not to volatilise the hydrocarbons—that is, so that no smell, or only a very faint aromatic odour, is observable—a matter much more easy of execution than might be supposed. Use an Argand spirit-lamp instead of a Bunsen burner, to avoid possible absorption of sulphur from the flame of coal gas. Keep at a low temperature for some time; then raise the heat by slow degrees (without letting it reach that of visible redness) until the surface, which is at first of a dark grey colour, becomes only faintly grey. No smoke or odorous gases should escape during the whole of the oxidation. When the surface becomes only faintly grey, raise the temperature to a faint red heat, and keep it stationary for about 40 to 60 minutes, at the end of which time the mass will become almost perfectly white, or reddish if the coal contains iron, from the complete combustion of the coal. The mass is then treated with water, filtered, and the sulphate is determined in the filtrate as usual after acidification. To succeed in the complete oxidation of coal by this method, it is most important to pulverise it as fine as possible. The best plan is to sift it through cotton cloth. . . . Stirring the mixture during the oxidation impedes the process instead of hastening it, probably by closing the passages left by the unconsumed coal.

If the above directions are well carried out, the method leaves nothing to be desired.

It is necessary to distinguish between the sulphur which goes over in the volatile matter, the sulphur left in the coke (which, however, can be converted into sulphurous acid by combustion), and the sulphur which is finally left in the ash combined as sulphate. For this purpose three determinations are required—

1. Total sulphur by Nakamura's method.
2. Sulphur which is converted into sulphurous acid by combustion of the coke in air. This can be done by roasting a quantity of coke representing a known quantity of the coal on platinum foil in a glass combustion-tube, and aspirating the gaseous products of combustion through a solution of iodine or bromine.
3. Determination of sulphur in ash. This can be done in most cases by boiling the ash with a little hydrochloric acid, filtering and determining the sulphuric acid in the filtrate in the usual manner, or by fusion with alkaline carbonates.

Proximate Analysis of Australian Shale (sp. gr. 1040·1).

Water lost at 100° C.	0·11	—
Volatile matter	77·69	Corrected for sulphur.
Fixed carbon	5·56	„ „
Ash	15·83	„
Sulphur in volatile matter	0·18	0·4518
„ fixed carbon		0·0121
„ ash		0·0137
	100·00	

The practical method partakes of two forms—a partial imitation of the process of gas-making on a small laboratory scale. This method has the advantage of being rapid and fully under control, and being effected in small compact closed apparatus, can be

conducted without any of the losses of a large manufacture, and gives us as a result an ideal that cannot perhaps be entirely reached in a large-scale manufacture; yet tells at once what is in the coal, and what we must try to secure in our works. The other practical method is by conducting a gas manufacture just as in actual practice, with large plant such as is in vogue.

Laboratory Practical Analysis.—The apparatus consists of a small and accurate weighing-machine, provided with an arm scaled to hundredths of a pound and capable of easily turning to this quantity. A cast-iron retort 3ft. 6in. long, of D section 5 × 3½, closed at one end, set horizontally over a furnace, with flues so arranged as to admit of its being evenly heated to any required reasonable temperature. A length of about four inches of the open end is left clear of the brick-work, to provide for the mouthpiece lid and ascension pipe. A chimney, fitted with a damper, is arranged in connection with the flues, to create a draught capable of regulation. The open end of the retort protruding from the brickwork has fitted to it a lid or door hinged on the left hand side, fitted with a cross-bar, which engages in a catch in the right hand side of the mouth of the retort, and a screw arrangement for pressing the lid to the end of the retort so as to hermetically close it, both mouthpiece end and door being properly faced.

On the top of the protruding end of the retort, and at right angles to it, a 2in. pipe, provided with a cock, is screwed in to form the ascension pipe and valve for closing it off from the other apparatus. From the ascension pipe, a rather smaller one (say 1½in.) is carried at a height of about 7ft. from the floor, so as to allow of head-room, and is turned down again to connect to a condenser conveniently placed against a wall, so as to be out of the way. This condenser is made up of about 60ft. run of a ¾in. pipe, provided with cocks to run off the tar and liquor which collects. These pipes are placed in a water tank. The inlet to the condenser is fitted with a cock, and the outlet to two small cast-iron purifiers, 12in. × 12in. × 6in., having cast-iron lids dropping into water-tubes cast on the sides of the purifiers. The weight of these lids is sufficient to hold them in their places without fastening. The inlet to these purifiers is at the bottom; and about 2in. above, on small feet, is a wooden grid to hold the purifying material (moist slaked lime), a small tube-like arrangement is cast on the inside leading from the top to the bottom, down which the gas passes, after having traversed upwards through four inches of lime, and then by a piece of gas-piping to the inlet of the second purifier, which is similar in all respects to the first. To the outlet of the second purifier is a pipe leading to the inlet of the gas-holder. This gas-holder has a capacity of about 12 to 13 cubic feet, and carries on it a vertical brass scale accurately divided into cubic feet, tenths and hundredths. The holder works in a cast-iron tank filled with water, and is fitted with rollers, top and bottom, for guiding it in its passage up and down. The rollers at the top are two in number, and work against a guide-rail placed on two upright pillars mounted on the top of the tank, opposite each other. These pillars are connected by a crosshead, whereon is mounted a wheel, over which travels a strong wire cord, connected at one end to the centre of the crown of the gas-holder, and at the other to an iron rod and circular plate, to carry the counterpoise weights—slotted circular discs of cast-iron. A pipe which passes up through the tank above the water-line serves as inlet and outlet by an arrangement of 3 cocks on each leg of a T piece placed outside. The gas can be caused to either enter the holder from the purifier, or go out from it to the photometer, or go from the purifier to the photometer direct, without communication with the holder. To compensate for the increasing weight of the gas-holder when rising out of the water, a special counterpoise is arranged, which need not be specially described. The crown of the holder is flat, excepting at the centre, where there is a sort of cap just over the ascending pipe, which is a few inches above the crown when the holder is down. The object of this is to enable the water to nearly fill the crown of the holder without flowing over the top of the ascending pipe, and thus stopping the flow of gas. As even then some water might by accident get over, a small plug or tap is placed in the pipe outside the tank to admit of the removal of such water. A thermometer and water-gauge are mounted with the holder to indicate the pressure and temperature. When gas is entering the holder from the retort during an experiment, the holder is counterpoised so that the the water-gauge is level. When it is desired to remove gas from the holder, as in testing it by the photometer, weights are taken off the counterpoise rod to produce any convenient pressure. Before commencing a trial, some of the coal to be tried is placed in the hot retort, and the gas allowed to enter the holder. This gas is blown back, and burnt at the mouth of the retort, the cock in ascension-pipe then closed, and the residue in the retort carefully raked out. Thus the whole apparatus is charged with gas of similar nature to that to be examined. Then the cock leading from the holder to the photometer, and the cock on the ascension-pipe being closed, and all other communication open, a quantity of 2·24lb. of the coal, or 1000th part of a ton, is introduced by means of a suitable long iron scoop into the hot retort and turned over. Three simultaneous operations have now to be performed. The scoop has to be drawn rapidly out with the right hand, and dropped; the left hand closes and screws up the lid or door of the retort, and the right hand being free, opens the cock on the ascension-pipe. With practice, this combined operation can be so performed that no gas escapes. The gas then passes through the condenser and purifier into the holder, and in a quarter to half-an-hour, according to the heat and nature of the coal, all gas is extracted. To ascertain when this is complete, the gas-holder scale can be watched till it remains stationary. But I prefer also placing a water-gauge on the pipe leading to the condenser, and by shutting the tap on the inlet before mentioned, observing whether there is any movement of the gauge, which there would be if any gas were coming from the retort. This point satisfactorily settled, the cock on ascension-pipe can be closed, the retort door opened, and the coke raked out into an iron pan, and carefully weighed. The tap on the inlet gas-holder being closed, and the one leading to the photometer open, the illuminating power can be determined according to usual methods. It will be observed that this apparatus, as above-described, only provides for three results. (1.) The quantity of gas. (2.) Its illuminating power. (3.) The weight of residual coke. But by means of a conveniently-designed condenser, I have found it possible to obtain a fairly accurate idea of the quantities of tar and gas-liquor yielded; but, as no scrubbing operation is arranged for, the total quantity of ammonia is not obtainable. These two quantities—the tar and ammonia—are generally neglected on this form of testing apparatus; the chief desideratum being a rapid means of finding the gas-making value of the coal. The volume of gas, if collected in the holder, is of course corrected for temperature and atmospheric pressure to the standards of 60° F. and 30° Bar. by means of the table on pages 660 and 661.

This apparatus, properly and intelligently handled, gives results of the utmost value to the gas-maker;

CORPORATION OF NOTTINGHAM.

GAS DEPARTMENT.

TABLE TO FACILITATE THE CORRECTION OF THE VOLUME OF GAS AT DIFFERENT TEMPERATURES AND UNDER DIFFERENT ATMOSPHERIC PRESSURES.

Baro-meter.	THERMOMETER. 40°	42°	44°	46°	48°	50°	52°	54°	56°	58°	60°	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	82°	84°	86°	88°	90°	92°	94°
28·0	·979	·974	·970	·965	·960	·956	·951	·946	·942	·937	·932	·927	·922	·917	·912	·907	·902	·897	·892	·887	·881	·875	·870	·865	·859	·853	·847	·841
28·1	·983	·978	·973	·969	·964	·959	·955	·951	·945	·941	·936	·930	·926	·921	·916	·911	·905	·900	·895	·890	·884	·879	·873	·868	·862	·856	·850	·844
28·2	·986	·981	·977	·972	·967	·963	·958	·953	·949	·944	·939	·934	·929	·924	·919	·914	·909	·904	·898	·893	·887	·882	·876	·871	·865	·859	·853	·847
28·3	·990	·985	·980	·976	·971	·966	·961	·957	·952	·947	·942	·937	·932	·928	·922	·917	·912	·907	·902	·896	·891	·885	·880	·875	·868	·862	·856	·850
28·4	·993	·988	·984	·979	·974	·970	·965	·960	·955	·951	·946	·941	·936	·931	·926	·921	·915	·910	·905	·900	·894	·888	·883	·878	·872	·866	·860	·854
28·5	·997	·992	·987	·983	·978	·973	·968	·964	·959	·954	·949	·944	·939	·934	·929	·924	·919	·914	·908	·903	·897	·892	·886	·881	·875	·869	·863	·857
28·6	1·001	·995	·991	·986	·981	·977	·972	·967	·962	·958	·953	·947	·943	·938	·932	·927	·922	·917	·912	·906	·901	·895	·889	·884	·878	·872	·866	·860
28·7	1·004	·999	·994	·990	·985	·980	·975	·970	·966	·961	·956	·951	·946	·941	·936	·931	·925	·920	·915	·909	·904	·898	·893	·887	·881	·875	·869	·863
28·8	1·007	1·003	·998	·993	·988	·984	·979	·974	·969	·964	·959	·954	·949	·944	·939	·934	·929	·924	·918	·913	·907	·901	·896	·890	·884	·878	·872	·866
28·9	1·011	1·006	1·001	·997	·992	·987	·982	·977	·973	·968	·963	·958	·953	·948	·942	·937	·932	·927	·921	·916	·910	·905	·899	·893	·887	·881	·875	·869
29·0	1·014	1·010	1·005	1·000	·995	·990	·986	·981	·976	·971	·966	·961	·956	·951	·946	·941	·935	·930	·925	·919	·914	·908	·903	·897	·891	·885	·879	·873
29·1	1·018	1·013	1·008	1·004	·999	·994	·989	·984	·979	·975	·969	·964	·959	·954	·949	·944	·939	·933	·928	·923	·917	·911	·906	·900	·894	·888	·882	·876
29·2	1·021	1·017	1·012	1·007	1·002	·997	·992	·988	·982	·978	·973	·968	·963	·958	·952	·947	·942	·937	·931	·926	·920	·914	·909	·903	·897	·891	·885	·879
29·3	1·025	1·020	1·015	1·011	1·006	1·001	·996	·991	·986	·981	·976	·971	·966	·961	·956	·950	·945	·940	·935	·929	·923	·918	·912	·906	·900	·894	·888	·882
29·4	1·028	1·024	1·019	1·014	1·009	1·004	·999	·995	·990	·985	·980	·975	·969	·964	·959	·954	·949	·943	·938	·932	·927	·921	·915	·909	·903	·897	·891	·885
29·5	1·032	1·027	1·022	1·018	1·013	1·008	1·003	·998	·993	·988	·983	·978	·973	·968	·962	·957	·952	·947	·941	·936	·930	·924	·919	·913	·907	·901	·895	·889
29·6	1·036	1·031	1·026	1·021	1·016	1·011	1·006	1·001	·996	·992	·986	·981	·976	·971	·966	·960	·955	·950	·944	·939	·933	·927	·922	·916	·910	·904	·898	·892
29·7	1·039	1·034	1·029	1·025	1·019	1·015	1·010	1·005	1·000	·995	·990	·985	·980	·974	·969	·964	·959	·953	·948	·942	·937	·931	·925	·919	·913	·907	·901	·895
29·8	1·043	1·038	1·033	1·028	1·023	1·018	1·013	1·008	1·003	·998	·993	·988	·983	·978	·972	·967	·962	·957	·951	·946	·940	·934	·928	·922	·916	·910	·904	·898
29·9	1·046	1·041	1·036	1·031	1·026	1·022	1·017	1·012	1·007	1·002	·997	·991	·986	·981	·976	·970	·965	·960	·954	·949	·943	·937	·932	·925	·919	·913	·907	·901

30·0	1·050	1·015	1·010	1·035	1·030	1·025	1·020	1·015	1·010	1·005	**1·000**	·995	·990	·985	·979	·971	·968	·963	·958	·952	·916	·911	·935	·929	·923	·917	·910	·901
30·1	1·053	1·018	1·013	1·038	1·033	1·029	1·024	1·019	1·011	1·009	1·003	·998	·993	·988	·983	·977	·972	·966	·961	·955	·950	·911	·938	·932	·926	·920	·913	·907
30·2	1·057	1·052	1·017	1·012	1·037	1·032	1·027	1·022	1·017	1·012	1·007	1·002	·996	·991	·986	·980	·975	·970	·961	·959	·953	·917	·911	·935	·929	·923	·916	·910
30·3	1·060	1·055	1·050	1·015	1·010	1·036	1·030	1·025	1·020	1·015	1·010	1·005	1·000	·995	·989	·981	·978	·973	·968	·962	·956	·950	·915	·938	·932	·926	·919	·913
30·4	1·061	1·059	1·051	1·019	1·011	1·039	1·031	1·029	1·021	1·019	1·011	1·008	1·003	·998	·993	·987	·982	·976	·971	·965	·959	·951	·918	·911	·935	·929	·922	·916
30·5	1·067	1·062	1·057	1·052	1·017	1·012	1·037	1·032	1·027	1·022	1·017	1·012	1·006	1·001	·996	·990	·985	·980	·971	·969	·963	·957	·951	·915	·939	·933	·926	·920
30·6	1·071	1·066	1·061	1·056	1·051	1·016	1·011	1·036	1·031	1·026	1·020	1·015	1·010	1·005	·999	·991	·988	·983	·977	·972	·966	·960	·951	·918	·912	·936	·929	·923
30·7	1·071	1·069	1·061	1·059	1·051	1·019	1·011	1·039	1·031	1·029	1·021	1·018	1·013	1·008	1·003	·997	·992	·986	·981	·975	·969	·963	·957	·951	·915	·939	·932	·926
30·8	1·078	1·073	1·068	1·063	1·058	1·053	1·018	1·013	1·037	1·032	1·027	1·022	1·017	1·011	1·006	1·000	·995	·990	·981	·978	·972	·967	·961	·951	·918	·912	·935	·929
30·9	1·081	1·076	1·071	1·066	1·061	1·056	1·051	1·016	1·011	1·036	1·031	1·025	1·020	1·015	1·009	1·001	·998	·993	·987	·982	·976	·970	·961	·958	·951	·915	·938	·933
31·0	1·085	1·080	1·075	1·070	1·065	1·060	1·055	1·019	1·011	1·039	1·031	1·029	1·023	1·018	1·013	1·007	1·002	·996	·991	·985	·979	·973	·967	·961	·951	·918	·912	·936
31·1	1·088	1·083	1·078	1·073	1·068	1·063	1·058	1·052	1·017	1·012	1·037	1·032	1·026	1·021	1·016	1·010	1·005	·999	·991	·988	·982	·976	·970	·961	·957	·951	·915	·939
31·2	1·091	1·086	1·081	1·076	1·071	1·066	1·061	1·055	1·050	1·015	1·010	1·035	1·029	1·021	1·019	1·013	1·008	1·002	·997	·991	·985	·979	·971	·968	·961	·955	·919	·913

ILLUMINATING POWER OF GAS.

To Correct the illuminating power in Candles DIVIDE by the Tabular number due to Temperature and Pressure.

Gas Office, George Street,
Nottingham, July, 1883.

EXAMPLE:—Observations	1)	8·1
	2)	8·
BAR. 29·1	3)	8·1
THER. 60°	4)	8·5
TAB. No. ·969	5)	8·6
	6)	8·6
	7)	8·6
	8)	8·5
	9)	8·6
	10)	8·6
Average		8·42
Candles, grs.		40
	20)	336·8
TAB. No. ·969)		16 81
Corrected Illuminating Power		17·38

VOLUME OF GAS.

To Correct the volume of Gas as registered by the Station Meter MULTIPLY by the Tabular number due to Temperature and Pressure.

EXAMPLE:—Gas made—2,163,000 cub. ft. at 30·1 in BAR. and 63° THER.
MULTIPLYING by TAB. No. ·995

2,152,185 cub. ft. corrected volume.

but since there are no losses, as in a great manufacture, and for other reasons to be explained later, the results are always higher than those found in actual working practice. They give, subject to what I shall have afterwards occasion to remark respecting influence of temperature, and containing vessel of distillation, what is in the coal, and what the gas-maker must endeavour to produce on the working scale.

For many reasons, in a large gas undertaking it is desirable to have more practical and extensive information concerning the quality of various coals, and their all-round behaviour in large working plants that experience has evolved. For instance, the retort now-a-days must be of fire-clay, the cost of wear and tear of iron being prohibitory. Then an exhauster is required to relieve the retort of pressure, since a system of counterpoised holders would not be practicable. To enable coal to be tested under the actual conditions obtaining in a modern gasworks, the Gas Committee of Nottingham decided to erect a small gasworks, which is to all intents and purposes part of the manufacturing plant. At one end of one of the retort houses was a coal store, and in this was erected exhausting, condensing, scrubbing, purifying, and gas-measuring plant capable of dealing with one, two, or three sets of retorts in regular work. Thus the expense of any special buildings, retort settings, and gas-holder was obviated, the simple addition being the plant above-mentioned. Thus, gas from sets of retorts as ordinarily worked, could be separately measured and examined, and the fullest information obtained in a practical and useful manner concerning any coal. The hydraulic main connected with the above-mentioned three sets of retorts was by means of diaphragms made into three sections, one for each set, and by suitable arrangement of pipes and valves one, two, or all of these sets could be connected with the special testing plant, or with the plant of the regular gasworks. The gas, then, from one, two, or three sets can be separately carried to a Pélouze and Audouin condenser, then to a steam jet exhauster water condenser, two scrubbers (one for washing the gas with ammoniacal liquor and the other with clean water), to two purifiers charged with lime, small station meter that had been in use for a somewhat suitable purpose, and was of admirable construction and ample size for the purpose, and finally to one of the works' gas-holders. By proper arrangements of steam traps and governors a very perfect vacuum is secured (this is a point of utmost importance), all the connections and plant are of sufficient size, so as to avoid obstructions and to prevent undue and unequal resistances. Thermometers and water gauges are connected to every important part of the apparatus. A small steam pump for circulating the liquor through the first scrubber, water meter to measure the quantity of clean water added, and proper valves to all the plant. The station meter was brought to exact agreement by numerous tests with a standard test meter, made by a celebrated maker, which corresponded accurately with two standard gas-holders made by different competent makers. The whole plant from retorts to meter is perfectly open to observation, and the pipes are above ground. There has been no trace of leakage, but any would be immediately observed. The seals of condensers and scrubbers are connected to a tank accurately made, so as to contain 10 gallons to the inch. In this the tar and liquor made is measured, but as it is sometimes difficult to find the exact level of separation between the tar and liquor, the former at the end of every twenty-four hours is pumped into a separate measuring tank, to confirm the measurements obtained from the other. The coal to the setting of retorts—each of which consist of fourteen single or seven through retorts, 18 × 13, D section, 18 feet through—is weighed on a machine continually checked, but examined also once a year, together with all the others in the works, by the maker. The weighings are also checked by the gross and tare weights of the coal wagons as they come in and go out of the yard. The coke drawn out is also accurately weighed, and its quality and appearance observed. The retorts are charged as regularly as possible to obtain the proper regularity of quality, and generally carry 2 cwt. charges in five hours; but this, of course, is varied if required. In that manner the normal weight of coal per set per twenty-four hours is 6 tons, 14 cwt., 2 quarters. No charge is drawn unless properly burnt off. Each hour the meter index and thermometer and jet photometer and Giroud's verificateur readings are taken and recorded. Every two hours the gas is further tested in a first-class photometer provided with a Methven standard burning town works gas, which is of very regular illuminating power. Daily the gas, on outlet of scrubbers, is quantitatively tested for the slight trace of ammonia which occurs in gas, washed clean to litmus paper; for sulphuretted hydrogen carbonic acid gas and cyanogen compounds. Samples of tar and ammoniacal liquor are taken and tested, a quantity proportionate to the day's make being saved and collectively analysed at the completion of the trial, which generally lasts seven days to secure a good average. Every day also the gas is tested for CS_2. The volume of gas registered is corrected daily by the average of the thermometer readings of the meter and barometer records, by means of the table before referred to. Every effort is made to secure absolute accuracy of observations, and various analyses not above specified are made from time to time, to obtain a knowledge of the coal and its products of distillation, and in contiguity to the two plants is a chemical laboratory, where the analyses are made by approved methods.

With a large testing works like the one at Nottingham, it will be evident that on first starting a trial after the plant has been standing, say for some days, a little time will be required to get it into normal working, since the seals and other parts are charged with tar and liquor from a previous trial of perhaps a totally different coal; the scrubbers, condensers, etc., are drained free from liquid products, and the whole apparatus is filled with stale gas; and even if the plant has been in work immediately before changing over from one coal to another, some of the above conditions will apply. For reasons founded upon the above and similar considerations, the first 24 hours' work, though accurately recorded, is not to be considered satisfactory. We generally arrange for a week's working, which, with the deductions of the first day and Sunday, gives a five days' average. It will be useful to state that subject to the influence of temperature of distillation, as indicated by the volume of gas made per ton, the result "candles per ton," from one day to another is generally satisfactory, and even when an occasional discrepancy arises, it is due often to difficulties in photometer testing, and would be removed if, instead of calculating the results from the bar photometer, we employed the average of the hourly readings of the inferential tests, such as Giroud's verificateur or Lowe's jet photometer. The yields of coke and tar from day to day are fairly concordant, but the variations of ammonia are always large and quite outside any possibility of experimental error. This matter of ammonia has received a deal of attention, and the results must be accepted as an index of the true behaviour of this nitrogen product of coal distillation. We find in testing the crude gas of our gas-works the same variations from hour to hour, and I have frequently had occasion to observe this

peculiarity in London. I have been making some inquiries into the cause of this variability, but up to the present am only in the position to say that it is not due to certain influences I had suspected.

Day of trial.	Cubic feet per ton corrected.	Illuminating power.	Candles per ton of coals.	Coke (cwts. per ton).	Tar (gallons per ton).	Ammonia (gallons per ton of 10oz.).	Sulphur other than H_2S, grains p. 100 c. ft.	Grains of CO_2 p. 100 c. ft. of washed crude gas.	Grains of H_2S p. 100 c. ft. of washed crude gas.	Cyanogen in grains of NH_3 p. 100 c. ft.	Average of jet photometer.	Average reading of Giroud's verificateur.	Carbonic oxide per cent.
						CANNEL COAL							
2.	9,515	23·17	44,231	12·70	21·10	28·53	—	3017	610	39·38	4·12	89·5	6·3
3.	10,117	22·09	44,829	11·39	20·49	31·27	21·53	3031	539	38·18	4·50	92·3	7·2
4.	10,151	22·33	45,331	12·72	20·56	27·03	25·06	2947	570	36·61	4·20	90·5	8·3
5.	9,852	22·69	44,708	11·98	19·95	23·12	26·46	3142	481	38·00	4·15	—	8·0
6.	10,000	22·56	45,120	11·91	19·95	26·85	21·17	3391	363	37·67	4·17	95·0	7·6
				NUTS FROM A DERBYSHIRE COLLIERY.									
2.	9,705	16·96	32,919	12·39	11·55	20·55	52·96	1227	935	—	6·05	122·5	5·9
3.	9,848	16·51	32,518	12·35	12·11	20·92	58·86	1441	1010	38·56	6·30	121·6	6·4
4.	9,558	16·39	31,331	12·61	11·55	19·01	55·36	1332	986	38·26	6·50	120·3	6·4
5.	9,848	16·31	32,124	11·71	11·36	17·45	56·81	1250	990	36·53	6·00	121·3	—
6.	9,852	16·01	31,516	12·50	11·55	20·75	—	1189	985	37·55	6·06	125·2	6·2
						CANNEL COAL.*							
5.	10,298	22·26	45,817	12·11	22·72	25·30	23·17	2818	231	36·92	4·22	94·16	6·8
6.	10,111	23·07	46,652	12·20	19·43	28·66	22·05	—	—	—	4·26	95·25	6·3
7.	10,461	22·16	46,363	12·57	21·10	21·82	35·02	—	—	—	4·27	95·66	6·9
8.	9,996	22·18	44,312	11·83	21·00	22·70	27·86	2600	337	—	4·20	94·12	7·0
9.	9,918	23·10	45,960	11·43	23·80	28·12	35·81	2912	363	38·78	4·16	94·00	6·7

* This cannel is from an entirely different seam to that which produces the cannel that heads this list.

It will be expected that I should say something about the practical values of the various methods of analysis.

As to elementary analysis, can one, from an inspection of numbers giving the elementary composition of a coal, offer a positive or even approximately valuable opinion concerning its uses to a gas-maker? I would reply certainly not, as far as our present information goes. It would take too much time to enter into my reasons for this statement, but an inspection of published analyses and gas-making results of various coals will, I think, convince anyone of the justness of the above-expressed opinion. I think, however, that, where possible, an elementary analysis should be made of samples under practical test, for the composition of the same seam varies so, that unless the two analyses represent the same bulk, anything like a close comparison could not be made.

It is equally impossible also to form a definite or valuable judgment of the gas-making properties of a coal from the proximate analysis. Of course, broadly, we can assume that the gas-making value varies with the volatile matter, less moisture—for instance, Australian shale, with 77 per cent. v.m., gives 140,000 candles per ton, and a Derbyshire or Yorkshire coal, with 35 per cent. v.m., about 35,000 candles per ton.

For absolute practical information respecting a gas-making coal, we are driven to a practical analysis.

As to the value of proximate analysis—when other practical methods are used, the results peculiar to proximate analysis—viz., volatile matter (not including water at 212°) and coke are not so valuable, except perhaps in confirming what is found in practice. From a proximate analysis alone we can gather but little information as to the value of a coal for gas-making purposes; it might expose a bad coal, but could hardly make as sure of a good one. The coke result accords, in my experience, remarkably well with the more practical ones. Thus, a Derbyshire coal gave 38 per cent. v.m., leaving 62 per cent. of coke, or 12·4 cwts. per ton. The laboratory practical analysis with iron retort (9 experiments) 12·37 cwts. per ton, with clay retorts (27 experiments) 12·39 cwts. per ton. In another case—

Proximate analysis......	63·83 per cent., or 12·76 cwts. per ton.
Laboratory practical analysis	12·77 ,, ,,
Works practical analysis	12·69 ,, ,,

The laboratory practical analysis with iron retort is of great value, but it will be necessary in interpreting the results to recollect that the method of heating the coal is different to that used in practice with clay retorts. In the former, the heat is quickly conveyed through the metal vessel, and there is no doubt in my mind that an iron vessel exerts a chemical action upon the gas made therein. As far as volume and quality of gas are concerned, we always obtain better results with the small iron retort than with clay.

But it is most important to consider the influence of temperature upon the results. It is customary to consider that within certain practical ranges of temperature the product of volume of gas yielded by its luminosity—*i.e.*, cubic feet per ton × illuminating power per cubic foot per hour—is a constant for each coal. As we decrease the one factor, we proportionately increase the other. When we say that a ton of coal contains—say 9000 cubic feet per ton, we do not mean that there is that fixed quantity and no more nor less in it, but simply that under certain conditions of distillation that quantity of coal yields 9000 cubic feet,

and it is implied that by either raising or lowering the mean temperature of distillation, more or less gas of more or less luminosity is produced. Now, it is important to enquire whether the variations in the two factors are proportional to each other, or, in other words, whether the product of quantity by luminosity is a constant for each coal. It is difficult to know what is the current opinion on this point. Dr. Schilling in his "Handbook of Coal-Gas Lighting," speaks of the economy of "high heats" in a general manner, but also publishes the following table, from which it might be inferred that with an increase in the "heat" there is a decrease in the total luminosity afforded by a given weight of coal.

	An Increased yield of gas.	A decreased illuminating power.
Zwickau Coal......	18 per cent.	14 per cent.
Saarbrück Coal ...	18 ,,	21 ,,
Bohemian Coal ...	25 ,,	30 ,,
Old Pelton Coal ...	24 ,,	38 ,,
Westphalian Coal	15 ,,	40 ,,
Stockheim Coal ...	20 ,,	42 ,,

With the exception of the first result on the list, my own experience differs from his, for I have always found, with carefully and properly conducted experiments, that with any coal I have experimented with, the product of volume by illuminating power increases with the volume.

In a paper on the influence of temperature of distillation in the composition of coal gas, to be found it the *Journal of the Chemical Society*, March, 1884, I showed the influence of temperature in bringing out the light-affording power of coal, thus :—

Gas coal distilled at a temperature to yield in cubic feet per ton.	Illuminating power per 5 cubic feet per hour.	Candles per ton, or yield by candles per cubic foot.
8,250	20·5 candles.	33,825
9,693	17·8 ,,	34,510
10,821	16·75 ,,	36,250
12,006	15·6 ,,	37,460

Taking the first and last results, we find that with an increased yield of 45½ per cent., there is only a decrease in the illuminating power of 24 per cent.; and that there is a net gain of 11 per cent. by working at the higher temperature. The following table will indicate this for a number of different coals. It is important that I should emphasise this fact that the product of volume by illuminating power increases with the volume.

Gas per ton. Cubic Feet.	Illuminating Power, Candles.	Candles per ton (Clay retorts).
	Cannel Coal.	
9350	24·99	46,731
9536	25·08	47,832
9798	25·27	49,519
9801	25·79	50,553
	Yorkshire Gas Coal.	
10,735	15·26	32,763
10,882	15·49	33,712
11,212	15·24	34,174
	Shale.	
7451	25·48	37,970
8160	24·16	39,429
8311	23·78	39,527
	Cannel.	
9,411	20·23	38,077
10 909	19·15	41,781
	Derbyshire Coal.	
9,411	15·34	28,873
10,147	14·94	30,319
10,294	15·30	31,499
10,313	15·35	31,661
10,757	15·27	32,852
	Derbyshire Nuts.	
9,558	15·49	29,611
10,454	15·30	31,989

I have before compared the yields of coke obtained by proximate analysis and practical methods. I now propose to consider the results obtained by the two practical methods in ordinary use -viz., the small iron retort and setting of clay retorts identical to those used in regular gas manufacture. The iron retort is one inch, the clay retorts are three inches thick. For the same temperature difference between the inner and outer surfaces of these vessels, there is in the same time 170 times more heat passed through the iron than through the clay. The flue or outside temperature employed in the clay settings if applied to iron retorts, would bring them like water running into the fires in a few hours. Yet in working iron retorts in perfect safety, it is possible to get an efficiency of 140 cubic feet per square foot of heating surface out of them, a result much above the average of clay retorts. The apparent temperature applied to the coal is less with iron than with clay. Yet the effective temperature in distilling coal can be at least as great as is customary with the latter. Any determination of the practical or effective temperature of retorts by pyrometer at the end of a charge, or by the colour or appearance of the retort, is likely to prove illusory, for it is easy to get up a good appearance in them by undercharging. The best test to my mind is the amount of work they will perform in distilling coal expressed by the quantity of gas produced per superficial foot of heating surface per 24 hours.

I have found that with the small iron retort a better result is always obtained than with the large experimental works, but the difference varies with the kind of coal. With the very finest coking coals the difference is very small, and as the coking quality of the coal decreases, so the difference between the two methods of testing increases. With coals (not cannels) which scarcely intumesce at all the difference becomes very high.

Cannels also vary in the same manner, the difference in the results being always connected with differences in the qualities of the residues of distillation or cokes. This point is illustrated in the following table :—

	Clay Retort.		Iron Retort.		Difference per cent.
	Cubic ft. per ton.	Candles per ton.	Cubic ft. per ton.	Candles der ton.	
Average of 12 Derbyshire and Yorkshire Coking Coals........	10,410	33,600	11,040	36,600	9
Average of 5 Derbyshire and Nottinghamshire Non-Coking Coals............	9,156	27,330	10,430	33,820	23
Average of 14 Cannels from various Districts	9,930	42,360	10,630	49,850	18

I have stated the volume of gas produced per ton, so that in regarding the above figures, allowance can be made for difference naturally due to temperature, as measured by yield of volume.

Since the gas from the iron retort was not scrubbed, a deduction of about 3 per cent. should be made from the results of the small apparatus, to compensate for the slight loss of illuminating power suffered by the gas of the large experimental works in the washing process. When this allowance for washing is made there is really little difference between the two methods of testing in the case of caking coals, but the difference is quite irreconcilable with some coals. There are two cannels of a shaley character included in the above average of 14 cannels, which give differences of 22 per cent. and 31 per cent. respectively; and it is remarkable that these two materials yield residues on distillation hopelessly valueless as fuel, being little else than an earthy ash. The one which gives a difference of 31 per cent. was introduced to me with a splendid analysis made probably in an iron retort. On submitting the coal to test, it was found to be of very little value when carbonised in clay retorts, though it tested fairly well in the small iron vessel. It is known that the weight of the fixed residue of distillation in proximate analysis is dependent on the manner, degree, or extent of heating, and I have shown above that the amount of valuable gaseous products obtained from a coal will vary with the manner and extent of heating; and further, that the nature of the base or fixed residue of distillation has an important influence on the behaviour of coal submitted either to rapid or to slower distillation. It is within my experience as a gas-maker that with the same coal the character and appearance of the coke produced in gas manufacture is largely affected by the method employed in carbonising it. I have in my mind a class of coal the smudge from which produces the finest furnace coke (when coked in beehive ovens) in the world, and which is regarded by gas-makers as a splendid gas coke producing coal. This coal, if carbonised in clay retorts, working off 2cwt. charges in 5 hours, and affording about 115 cubic feet of gas per 24 hours per square foot of heating surface, gives a fine large metallic looking coke of hard steely appearance. If the retorts are worked at a higher average temperature, so as to burn off the 2cwt. charge in 4 hours, and to produce about 140 cubic feet of gas per square foot of heating surface, the coal will give a coke of inferior appearance to the other, being smaller and less metallic in appearance, with many black pieces. If carbonised in iron retorts carbonising 1¾cwts. in 5 hours, and giving 140 cubic feet of gas per square foot of heating surface, the coke is small, black, and of appearance much inferior to the others.

Enough has been said to show that the results given by the small iron retort in common use for testing gas-coals cannot be accepted as authoritative in these days, when only clay retorts are used in large works; and it must be in the experience of all gas manufacturers that many coals do not justify in practice the values assigned to them by analysts, who use what is called the laboratory analysis. It will be interesting also to know how far the results obtained in our gas works agree with the values assigned to the various coals we use by the experimental works in which they are all tested. I have carefully compared for a long period the actual working results of our daily manufacture with the theoretical average value of the mixture of coals and cannel we employ, calculated from the values of the respective coals as determined in the experimental works in their various proportions, and I find that we exceed in practice the theoretical field so calculated by 3 per cent. This amount is not large, but it is constant, ranging from about 2 to 4 per cent.; and is further, I believe, beyond the range of experimental error. This slight improvement is no doubt due to the admixture of low and high power gases, obtained from a 70 per cent. of coking coal, and 30 per cent. cannel coal before condensation commences, with the result that the low power gas carries forward some of the hydrocarbons of the cannel gas that would otherwise be condensed and removed from the gas by the tar. I may say that our station meters have been compared and standardised by the same standard meter used for standardising the experimental works station meter, and that the illuminating power used in calculating the candles per ton we obtain in our manufacture is the average of our official tests made in the centre of the town.

It is unfortunate that we have no proper classification of all the various kinds of coal which nature has produced. Such terms as caking splint coal, cherry coal, peacock coal, cannel coal, slate coal, leaf coal, coarse bitumenous, semibitumenous, are not sufficiently explicit. The Germans, I think, have a better, but even theirs I find wanting, as it is customary to classify a non-homogeneous coal, consisting of many varieties, under one name that may express its few united qualities more or less perfectly, but not satisfactorily. A piece of coal I have selected for your inspection contains at least three widely different kinds, first you will see layers of vegetable charcoal, then a material very like pitch, and finally cannel coal. The part forest fires may have played in the formation of these qualities has not received attention. It is difficult to examine this coal without imagining that it is the final result of charred wood fibre. The pitch having been a distillation product, and the cannel coal which occurs in a basin or huge pond, being an earthy base permeated with tarry distillation matters, and deposited in a liquid form. It is very common to find these three sorts of coal in contiguous layers, and yet the coal may be classed as caking coal. The Germans, I think, have given the names Russkohle and Pechkohle to the two first-mentioned varieties, but it is difficult, of course, to know always what German writers understand by the numerous titles they have for different sorts of coal. A complete classification and examination of our various British coals is wanting, and we have, I am sorry to say, no work similar to the extensive work of Drs. Geinitz, Fleck, and Hartig, on the coal of Germany. I fear we are accustomed to leave too much to individual effort.

Estimation of Sulphuretted Hydrogen and Carbonic Acid in Crude Coal-Gas.—For many reasons I prefer, for the estimation of hydrogen sulphide and carbonic anhydride in impure coal-gas, a method founded upon the increase in weight of absorption tubes; a method which will admit of the use of a tolerably large quantity of gas collected regularly during an interval of time sufficiently long to afford an idea of the average composition of the gas supply to be tested.

I have adopted as the reagent for absorption of hydrogen sulphide in absorption-tubes, a cupric phosphate, which is an impure di-, tri-, ortho-phosphate.

The cupric phosphate for use in absorption-tubes is prepared somewhat in the following manner:—

Solutions of—

2lb. hydrogen disodium phosphate in 1 gallon of water, and

2½lb. cupric sulphate crystals in 1½ gallons of water, are mixed with vigorous stirring, and the resulting bright blue precipitate washed by decantation and then dried in a water-bath to about 100°. The material sometimes is light and powdery, sometimes hard, and then requires crushing in a mortar. Its action with hydrogen sulphide is very sharp indeed.

The U-tubes used in these experiments are preferably of the new form with hollow glass round stoppers, serving as stopcocks, the inlet and outlet

connections being small pieces of glass tubing fused into the sides or the tubes. A small hole in the stopper corresponding to the hole in the side of the tube, where the small glass tubing is fused on, makes the connection. A small turn of the stoppers closes or opens the tube. The tubes are weighed charged with clean coal-gas, which on the same gas supply, varies but little in specific gravity.

The stoppers are lubricated with resin cerate, and with this exception are perfectly clean. A small plug of cotton-wool in each stopper prevents the mechanical carriage of fine proportions of the reagents by issuing gases. Under these circumstances, I find that closed tubes charged with coal-gas suffer no appreciable variations in weight during a period of two days. These tubes are very useful indeed, and are far superior to the old form with corks.

I find that absorption-tubes charged with cupric phosphate gain in weight under the action of clean coal-gas ; but the increase of weight soon reaches a limit, and the phosphate becomes "saturated," and to attain this saturation 3 cubic feet of clean dry coal-gas should be slowly passed through the tubes.

The phosphate tubes are charged in the following manner. The tubes are cleaned and dried, great attention being paid to the ground portions of the tubes and stoppers. A plug of cotton-wool is placed in the bend of the **U**-tube. Then one leg of the tube is charged with the cupric phosphate in a suitable state of subdivision, care being taken that the rough and fine portions of the powder are regularly distributed, for if all the rough portions are on one side and the fine on the other, a passage of the gas down the side where the coarse portions are takes place, and the finer portions never come into action. The other leg is charged with powdered calcium chloride. The ground portions of the tubes are wiped free from dust, and the stoppers, fitted with plugs of dry cotton-wool in the hollow places, are lubricated with a little resin cerate, and put in position. A current of dry gas-coal to the extent of 3 cubic feet is passed through, and the tubes are ready for weighing. A 6-inch **U**-tube charged in this manner will be capable of absorbing 20 grains of hydrogen sulphide, and if in the case of gas containing 10 grains of hydrogen sulphide per cubic foot, the experiments be made upon quantities of half a cubic foot, each will therefore serve for four analyses without being recharged. The calcium chloride will serve much longer.

The soda-lime tube for carbonic anhydride absorption is charged in the same manner, one half full of soda-lime, and one half of calcium chloride. I have found it necessary to use the soda-lime in a moist condition, for, when quite dry, soda-lime has a much feebler absorptive power for carbonic anhydride.

The requisite degree of moistness is attained by exposing it to a moist atmosphere for 12 to 18 hours. There are no inconveniences attending soda-lime in this condition. These soda-lime tubes remain very constant in weight when clean pure coal-gas is passed through them, and therefore do not require saturating in the same manner as the phosphate tubes : a small quantity of dry pure coal-gas should, however, be passed through to expel air, previous to their being weighed.

A 6-inch tube, charged with soda-lime in the manner above described, serves for three analyses of half a cubic foot each on gas containing 10 to 12 grains carbonic anhydride per cubic foot.

In cases where ammonia also exists in the coal-gas to be analysed for hydrogen sulphide and carbonic anhydride, it will be necessary to effect its removal before the coal-gas reaches the weighing tubes. That calcium chloride effectually removes ammonia from coal-gas I have frequently had occasion to notice, and Dibbits (*Zeits. für Analyt. Chem.*, **15**, 1876, 124) has made the same remark. But to maintain the neutrality of the calcium chloride I remove the ammonia from the coal-gas before drying, and for this purpose pass the gas through a 12-inch **U**-tube filled with broken pumice saturated with syrupy phosphoric acid.

In the drawing off of samples of coal-gas for analysis, certain precautions are indispensable, since vulcanised and iron tubing when new remove hydrogen sulphide from crude coal-gas, so that it is necessary to have the services conducting the coal-gas from the source to be tested to the absorption-tubes as short as possible, and saturated by previous use with crude coal-gas. It is further of importance to keep a tolerably quick current of gas through the iron pipe, in order to prevent the gas from getting "stale."

The iron service should be fitted with a four-way piece and three cocks. One serves to take the gas to the train of apparatus ; another to be left open during the analysis, blowing gas away, and thus maintaining a rapid current in the iron pipe ; the third cock can be used for other purposes, such as examination of the gas for ammonia, &c. Before making an analysis it is necessary to blow a little gas away in order to clear stale gas out of the iron service-pipe, and to bring a fresh supply along.

The complete apparatus for the estimation of hydrogen sulphide in coal-gas can now be described.

The first piece in the train is the syrupy phosphoric acid tube, which can however be dispensed with in cases where the gas has been thoroughly washed free from ammonia. This tube is directly connected with the cock on the iron pipe by means of a small piece of "saturated" vulcanised tubing. The outlet of this tube is connected to a large drying cylinder filled with small pieces of calcium chloride free from alkalinity. The outlet of this drying cylinder is a **T**-piece, which carries on one arm a small piece of vulcanised tubing and screw-clamp for the purpose of blowing a little gas away before and during each experiment. The other arm of the **T**-piece is connected to the inlet of the cupric phosphate tube, which in its turn is connected with the soda-lime tube, and a gas meter connected to the outlet of the soda-lime tube completes the apparatus. The meter most suitable for the purpose is the test-meter, as used by the gas referees for the "sulphur" test. It it advisable to bring the pointer up to within a division or so of the zero by means of the key, and then to blow through until the pointer exactly covers the mark. Any error due to slackness in the gearing of index is thus avoided. Before starting an experiment, gas should be blown away at the outlet of the drying cylinder, as well as at the cock on the iron service.

When the tubes have been weighed full of clean coal-gas, and all the pieces of the train properly joined together, the stopcocks are turned on, and the gas allowed to traverse the apparatus at a moderate rate, which is often more dependent on the pressure of the gas than the will of the operator. From a quarter to one half a cubic foot per hour is a convenient rate, and one well within the limits at which the complete action of the reagents is obtained.

The quantity of gas used for each experiment is a matter of choice, and will be determined by the quantity of impurity in the coal-gas under analysis. When the required quantity of gas has passed through the tubes, the inlet stopper of the phosphate tube and the outlet stopper of the soda-lime tube are turned off, and the two tubes are taken off together, and connected in their proper order to a supply of desiccated clean gas, in order to drive the gas in the phosphate tube through the soda-lime tube. The

stopper can then be turned off and the tubes weighed. Of course, before weighing these tubes, they must be wiped perfectly clean and dry; but as this operation causes them to be a little light, they should be left for about five or ten minutes in the balance case before being weighed. The results corrected for temperature, &c., are best calculated to a cubic foot of clean coal-gas at 60° F. and 30in. barometer.

Since washed but otherwise unpurified coal-gas contains about ·6 grain per cubic foot of cyanogen, the results obtained by this method are slightly high. The absorption of cyanogen in the cupric sulphide is not complete, about one half going forward into the soda-lime tube. The error falls equally on each tube.

Cyanogen.—This body is estimated by passing a measured quantity of gas free from ammonia, but otherwise unpurified, through a U-tube filled with soda-lime, and then making a combustion of the residue as in an ordinary nitrogen determination.

INTERNATIONAL INVENTIONS EXHIBITION, LONDON.

ADDENDUM TO REPORT ON THE EXHIBITS RELATING TO THE CHEMICAL INDUSTRIES.

BY WATSON SMITH,

Lecturer in Chemical Technology in the Victoria University, Manchester, etc.

* J. C. & J. Field, London (*Group XI. No.* 1192).

Beeswax.—Specimens were shown of the wax, air-bleached and bleached by the potassium bichromate method. The latter process, whilst giving the whiter product, yields a crystalline wax less suitable for burning than for the use of druggists.

Samples of church candles and carriage lights made from the wax were shown, and it is stated that Messrs, J. C. & J. Field made wax candles in 1680.

Spermaceti.—This is purified from the "head-matter" and crude oil by "bagging," or a process of filtration in which the weight of the substance is made available. About ten per cent. is recovered. Melting-point, 43° to 44° C.

This material is used for high-class candles, popular on account of the absence of the tendency to bend when placed in a warm atmosphere. Specimens of standard sperm gas-candles were shown, burning 120 grains per hour.

I am informed that Messrs. J. C. & J. Field made the first sperm candles in 1760, and that over 220 tons of wax and spermaceti are now manufactured per annum by the firm, about 400 tons of wax and sperm candles being employed in England and Ireland alone.

Stearin.—Specimens were shown prepared both by the "autoclave" process and by lime saponification. The product of the latter process shows the highest melting-point—viz., 56° C., and is better adapted for working up inferior greases.

The original candles from Milly et Cie., "*Bougies de l'Etoile,*" imported by J. C. & J. Field in 1835, were exhibited.

Paraffin.—The cruder material is refined by treatment with naphtha, and by the "banding" process—*i.e.*, passing through cogged wheels in an alkaline solution, which emulsifies the coarser oils. Melting-point of the refined product is about 51° C. J. C. & J. Field state that they were the first to make paraffin candles, and that they originally contracted with the Irish Peat Company and Young's Paraffin Company for the sole supply of their produce.

Ozokerite.—Introduced by F. Field, F.R.S., in 1872. The crude product from Gallicia is treated with superheated steam, when a purer paraffin distils over. The distillates obtained are—

(i.) A gaseous hydrocarbon, to the extent of about five per cent.
(ii.) A volatile naphtha. (About three per cent.).
(iii.) A "vaseline" product called "Ozokerine." (About six per cent.).
(iv.) A soft paraffin. (About twelve per cent. Melting-point 44½° to 46° C.).
(v.) A white paraffin (*Ozokerite*), with a melting-point of 61° C.
(vi.) A black waxy residual melting at 77° C.

The gas and naphtha are said to be useless. The ozokerine has a sale amongst chemists and hairdressers and in the hospitals, as a basis for pomades and unguents. It is also imported to France (Grasse) as a substitute for lard in "*enfleurage.*" The *soft paraffin* is employed in the manufacture of cheap candles, retailing at ½d. and 1d. This employment gave rise to the use of paraffin scale for that purpose, which has resulted in the death-blow to the tallow and composite candle trade.

The White Paraffin, Ozokerite proper, is employed for making the well-known ozokerite candles, which, it is stated, melt not only about six degrees (Centigrade) higher than any other paraffin or stearin candle, but bend at a much higher temperature. The flame of the candles is small and very brilliant. It is stated that equal candles of ozokerite and sperm give lights differing in the ratio of 10 : 7.

The Black Paraffin is largely used by electrical engineers as an insulator. Matthiessen found that it gave more complete insulation and possessed less induction capacity than any other known substance.

F. Field has patented an elastic compound of this wax with indiarubber, which has been adopted to some extent in the manufacture of cables.

Ornamental Candles.—Of these a large number is exhibited. Messrs. Field state that they patented every description of ornamental candle now made. The cable candles they still make with the lathe, having abandoned the machine, as giving results good, it is true, as regards quantity, but not equal as regards quality to the lathe candles. It is stated that by the use of the lathe patented by Messrs. Field, eighteen varieties and sizes can be turned out, ornamented with vertical and spiral stripes and six different cable patterns. To do this otherwise would require a corresponding number of machines, and certain varieties of the ornamental candles referred to cannot be made by any other than the lathe method.

Self-fitting Ends.—Of these Messrs. Field state that they were the original patentees, and for fourteen years have been the sole manufacturers. They still retain the original form—namely, with broad obtuse angled flutes, stating that ends shaped thus, by spreading out, perpetually resist the pressure, being fixed in their receptacles after the manner of wedges. The firm has, moreover, patented a very simple "wedge-end," which has the advantage of being made all in one piece like an ordinary candle.

Aërated Candles.—The patent for these was taken up in 1870 from M. Urbain. At the Exhibition the candles were made in a French machine, which for simplicity and efficiency appears superior to the English specimens. The rods which produce the perforations in the bodies of the candles are so constructed as not to crack the sides when withdrawn.

* Omitted on page 563, through information arriving too late for press.

Candle Machinery.—Besides the machine last referred to, Messrs. Field exhibit a new patent machine for making the self fitting ends. In the old method the caps that moulded the conical butts are withdrawn simply by hand, and replaced in the same manner, entailing a great deal of labour and sacrificing a considerable quantity of wick. In Field's machine a lever separates the coned moulds, thus allowing the candle to be wound out in the ordinary way. The time taken in liberating one set of candles and filling another is five minutes, in the old machine from twenty to thirty.

Soaps.—From the oleic acid obtained from the autoclave and saponification processes, J. C. & J. Field manufacture a brand of soap known as the "Pure Oil Soap," much used by dyers, etc. Their speciality in toilet soaps is the newly-patented "Samphire Soap," which is saponified by the use of iodised potash obtained from the ashes of seaweed, and palm and olein oils. The resulting soap is subsequently milled, after completely expelling every trace of water, and is de-alkalised by the introduction of salicylate of ammonium.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

An Improved Substance for Lining or Covering Steam Boilers, Pipes, and other objects. H. J. Allison, London. From Messrs. Sophus, Dohlmann & Company, Copenhagen, Denmark. Eng. Pat. 4343, April 8, 1885.

SAWDUST, chopped straw, cork, bark or other similar light substances are mixed with soluble glass and chalk or lime, in a pulverised state. The mixture thus obtained—formed into pieces adapted to the article it is intended to cover—is thoroughly impregnated with a boiling solution of calcium, magnesium or barium chloride or sulphate of alumina, and after washing in boiling water to free it from soluble salts, the substance, which is now incombustible, is ready for use.—A. W.

Improvements in Filters. E. M. Knight, Liverpool. Eng. Pat. 12,287, September 11, 1884.

A CYLINDRICAL vessel is formed with a concentric perforated cone; this is covered with asbestos cloth, and the annular space filled with charcoal, held down by a perforated cover, through which the water to be purified is admitted to the charcoal filtering bed. The whole is suspended in a porcelain vessel of the usual shape.—C. C. H.

Improvements in Filters. P. A. Maignen, London. Eng. Pat. 13,345, October 8, 1884.

THE conical or V-shaped filtering frames, such as hitherto used by the patentee, are made so that the lower part forms a wedge joint with the side of the vessel in which they are placed.—C. C. H.

Improvements in Filters. C. E. Gittins, London. Eng. Pat. 14,019, October 22, 1884.

THE filter consists of a series of chambers formed from perforated plates and distance frames. These are arranged alternately as supply and discharge chambers, communicating with closed inlet and outlet conduits, as in a filter press. The plates are covered with asbestos or other cloth, and the interior of the chambers filled with charcoal. The whole apparatus is provided with a nozzle, so as to be attached to the tap of a water supply.

—C. C. H.

II.—FUEL, GAS, AND LIGHT.

The Influence of Water on the Combustion of Carbon Monoxide, and the Occurrence of Hydrogen Peroxide in this Combustion. M. Traube. Ber. **18**, 1890.

DIXON has shown (*B. A. Rep.* 1880, 503; *Chem. News*, 46, 151; *Phil Trans.* 1884, 617) that a perfectly dry mixture of carbon monoxide and oxygen cannot be caused to explode either by incandescent platinum wires, or the continued passage of sparks from a Ruhmkorff's coil. The author has found, in confirmation of this result, that carbon monoxide already burning, is extinguished in a dry atmosphere. The author considers the influence of the water to be represented by the following equations:

$$(1)\ CO + 2OHH + O_2 = CO(OH)_2 + H_2O_2$$
$$(2)\ H_2O_2 + CO = CO(OH)_2$$
$$(3)\ 2CO(OH)_2 = 2CO_2 + 2H_2O.$$

That hydrogen peroxide is produced in the combustion of carbon monoxide, is shown by bringing the flame of the gas into contact with water, and then showing the presence of the peroxide in the water by the usual tests.

—F. L. T.

The Production of Hydrogen Peroxide in the Combustion of Hydrogen. M. Traube. Ber. **18**, 1894.

THE author failed to prevent the explosion of mixtures of oxygen (or air) and hydrogen by the electric spark, by having the mixture as dry as he could possibly make it, thus confirming Dixon's results. He confirms Schuller (*Wiedem. Ann. Chem. Pharm.* (1882) 15, 289) that hydrogen peroxide is produced by burning hydrogen in air, and finds by allowing the burning jet to impinge on the surface of water, that 100cc. of water can take up as much as 290mgrm. of the peroxide of hydrogen, figures indicating what seems to be the maximum concentration obtainable. The greatest amount of hydrogen peroxide produced from the combustion of 1 litre of hydrogen, was 0·0113grm. The size and shape of the jet at which the gas was burnt, the pressure, and the amount of air or oxygen, if any, mixed with the gas before burning, all exerted a perceptible influence on the amount of hydrogen peroxide produced.—F. L. T.

Influence of some Metals on a Mixture of Acetylene and Air. F. Bellamy. Compt. Rend. **100**, 1460—1461.

THE gases are mixed in a glass apparatus resembling a Bunsen's burner. If a platinum or silver wire, scarcely red-hot, be held in the mixture, it causes a detonation, but becomes only seldom, and then transiently and partially, white-hot; on the other hand a red glowing copper wire becomes, in a few seconds, white-hot, and then generally produces an explosion. Iron gives rise to the same phenomena, but with greater difficulty.

—F. L. T.

Combustion in Dried Gases. H. B. Baker. J. Chem. Soc. 1885, 349.

As H. B. Dixon has shown (*Chem. News*, **46**, 151; and *Phil. Trans.* 1884, 617) that a dry mixture of oxygen and carbon monoxide cannot be caused to explode by the electric spark, the author has investigated whether moisture is necessary in the combustion of the elements. Amorphous phosphorus, that had been washed with water and dried in a current of carbon dioxide at 100°, and afterwards in a vacuum at 150°, or wood charcoal that had been heated to bright redness in a current of chlorine, were sealed up with oxygen in difficultly-fusible glass tubes, some of which were slightly bent, and held phosphorus pentoxide in one limb. After about a week the phosphorus and charcoal were heated, but no ignition took place, whilst the same substances placed in similar tubes with moist oxygen, burnt as usual. Similar experiments with charcoal, in which the tubes were raised to redness, showed that, in the dry tubes, about half the oxygen remained uncombined; whereas, in the moist tubes, no trace of free oxygen was present. In the dry tubes visible combustion never occurred. These experiments, and some others where the charcoal

was submitted to the electric spark, show that the absence of moisture greatly retards the combustion of carbon in oxygen.—F. L. T.

Improvements in Machinery for Desiccating Coal and other Substances at Low Temperatures. H. G. Fairburn, Cardiff. Eng. Pat. 14,199, January 31, 1885.

THE material to be dried is placed on the floor of a closed chamber, practically exhausted of air, and to which a low external heat is applied. It is caused to move forwards over this floor by the action of a series of loose pendulous prongs, free to move in one direction only, and suspended from a frame, to which a slow reciprocating motion is communicated.—A. R. D.

Improvements in, or in Connection with, Apparatus for the Carburation of Gas in Railway and other Carriage Lamps and Lanterns. Peter Jensen, London. From J. E. Dery, Brussels. Eng. Pat. 8816, July 21, 1885.

THESE improvements are upon the apparatus referred to in Specification 10,675, July 28, 1884. Pipes are so disposed and provided with taps that, by suitable manipulation of these latter, the burner may be supplied with gas that either has or has not passed through the carburettor, or with any required mixture of the two.—A. R. D.

Improvements in and Apparatus for the Manufacture of Coke. J. Jameson, Newcastle-on-Tyne. Eng. Pat. 14,551, July 31, 1885.

THESE improvements relate to such coke-ovens as the "Jameson," from which the evolved gases are collected and treated for by-products. The gas passages in the bottom of the retorts are partly formed of T iron. This prevents the openings from being injured by the rakes, or from being clogged up by the deposit of hardened oil and dust, which settles upon brick. To provide greater cooling power a vertical pipe is placed between the oven and the main, of half the dimensions of the oven exit. Each of these cooling pipes is provided with a water gauge and an adjustable orifice by which the flow of the gas may be regulated. An expansion bar or pyrometer arrangement may be used to regulate the passage of the gas in an inverse ratio to its heat.—A. R. D.

Improvements in Coke-Ovens or Retorts, and in Apparatus connected therewith. John McCulloch, Airdrie. Eng. Pat. 15,821, August 31, 1885.

THIS invention relates to further improvements in the apparatus described in Specification 4122, of 1884. It comprises improved means of exit for the gases from the retorts; combustion chambers or flues combined with furnaces to ensure the perfect combustion of the gaseous fuel used; apparatus for utilising the heat of the volatile products for heating the air; and improved means of quenching the coke. For further particulars, the Blue Book, and its drawings, must be consulted.—A. R. D.

Improvements in Machinery for Compressing and Solidifying Coal and other Substances. H. G. Fairburn, Cardiff. Eng. Pat. 616, September 2, 1885.

THE inventor claims "the equal solidification and perfect division of compressed blocks of coal by means of a movable moulding die, working with a reciprocating motion, in line and in conjunction with a retaining tube." For further particulars consult the Blue Book.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Brominated Derivatives of Diphenyl, Tolylbenzene and Ditolyl. Thomas Carnelley and A. Thomson. J. Chem. Soc. 47, Trans. 586—593.

THE hydrocarbons used in the present investigation were obtained by passing the mixed vapours of benzene and toluene through a ret-hot tube (*J. Chem. Soc.* 37, 701).

1. The diphenyl, $C_6H_5.C_6H_5$, after crystallisation from alcohol, melted at 70° and boiled at 245° to 258°.

2. The 1 : 4 tolylbenzene, $C_6H_5.C_6H_4.CH_3$, was a colourless liquid, boiling at 263° to 268°, and on oxidation gave first 1 : 4 phenylbenzoic acid, melting at 216° to 220°, and finally terephthalic acid.

3. The 1 : 2 : 1′ : 4′ ditolyl, $CH_3.C_6H_4.C_6H_4.CH_3$, was a liquid, boiling at 272° to 280°, and on oxidation gave first 1 : 2 : 1′ : 4′ tolylbenzoic acid, $CH_3.C_6H_4.C_6H_4.COOH$, melting at 179° to 180°, and finally terephthalic acid.

Derivatives of Tolylbenzene.—Monobromo 1 . 4 tolylbenzene, $C_{13}H_{11}Br$, was prepared by brominating the hydrocarbon (boiling point 163° to 267°) obtained by the action of sodium on mixed monobromobenzene and 1 : 4 monobromotoluene. The compound melts at 131°, crystallises from alcohol in small pearly plates, and is readily soluble in benzene. *Dibromotolylbenzene*, $C_{12}H_7Br_2.CH_3$. Two isomeric modifications were obtained by the action of bromine on 1 : 4 tolylbenzene. By the oxidation of the mixed dibromo 1 : 4 tolylbenzenes, two *dibromophenylbenzoic acids*, $C_{12}H_7Br_2.COOH$, were obtained (melting point 202° and 232° respectively). *Monobromoditolyl*, $C_6H_4Me.C_6H_3BrMe$ = 1 : 2 : 1′ : (2′ or 3′) : 4′, was obtained by the action of bromine on 1 : 2 : 1′ : 4′ ditolyl. The product was dissolved in a large quantity of alcohol, from which, on cooling, a brown oil separated, followed by a large crop of crystals. The latter were separated from the oil, and were recrystallised from alcohol. Fine interlacing microscopic needles melting at 93° to 95° were obtained, yielding, on oxidation with chromic and glacial acetic acids, an acid melting at 304° to 309°. The oil referred to above was thoroughly dried and analysed, giving numbers agreeing with the formula $C_{14}H_{13}Br$. On oxidation, *monobromodiphenic* and *monobromophthalic acids* were obtained, the former melting at 215° Corr., and the latter at 203° Corr. The constitution of these acids is represented as follows:—Monobromodiphenic acid, $C_6H_4(COOH).C_6H_3Br.COOH$, 1 : 4 : 1′ : 4′ : 2′; monobromophthalic acid, $C_6H_3Br(COOH)_2$ = 4 : 2 : 1.

Dibromoditolyl, $C_{14}H_{12}Br_2$, was obtained by treating ditolyl dissolved in carbon disulphide with the calculated quantity of bromine. This compound crystallises in beautiful long, almost hair-fine, needles of brilliant lustre, melting at 156°. On oxidation, two brominated compounds of different melting point and composition were obtained (melting points 201° and 170° respectively).—D. B.

Constitution of Retene. E. Bamberger and S. C. Hooker. Ber. 18, 1750.

THAT the hydrocarbon retene is a methylisopropylphenanthrene, and has the constitution—

$$\begin{array}{l} HC - C_6H_4 \\ \;\;\| \qquad | \\ HC - C_6H_2(C_3H_7)(CH_3), \end{array}$$

appears from the following considerations:—

1. It has previously been shown that retenequinone contains the double ketonic group CO—CO.

2. On oxidation with $KMnO_4$, retenequinone is converted into a monobasic acid, $C_{17}H_{14}O_4$, which, since it forms a compound with hydroxylamine, must contain a ketonic (CO) group, and hence has the formula $C_{15}H_{13}O(CO)CO_2H$; this ketonic CO group is probably derived by oxidation of the CO—CO group, as in the formation of diphenylene-ketone from phenanthrenequinone.

3. By further oxidation of the monobasic acid, $C_{15}H_{13}O(CO)CO_2H$, by means of $K_2Cr_2O_7$ and H_2SO_4, a dibasic acid, $C_{15}H_8O_5$, is produced; this also reacts with hydroxylamine, and hence has the formula $C_{12}H_6(CO)(CO_2H)_2$; and since, on dry distillation of the silver-salt, it gives diphenylene-ketone, it must be a dicarboxylic acid of the latter—

$$OC\begin{array}{l} \diagup C_6H_4 \\ \quad | \\ \diagdown C_6H_2(CO_2H)_2 \end{array}$$

4. That the dibasic acid, $C_{15}H_8O_5$, has this constitution, is also supported by the fact that on fusion with

KOH it gives a diphenyltricarboxylic acid, and also that it is reduced by sodium-amalgam to a fluorenedicarboxylic acid.

5. From the above it follows that retenquinone must contain the skeleton

$$\begin{array}{l} OC-C_6H_4 \\ \;|\quad\;\; | \\ OC-C_6H_2'' ; \end{array}$$

and on to this skeleton we have to put C_4 and H_{10}; this may either be attached in the form of two side-chains or as a ring. The latter constitution, however, is excluded by the formation of the monocarboxylic acid, $C_{17}H_{14}O_4$, by limited oxidation, whereas a ring would be sure to give rise to a dicarboxylic acid. The two side-chains may be either a propyl and a methyl group or two ethyl groups. Since the first oxidation product, $C_{15}H_{13}O(CO)CO_2H$, contains only one C atom less than retenequinone, the CO_2H group must have been formed by the oxidation of a CH_3 group, the additional atom of O being probably derived by conversion of the propyl group into an oxypropyl group. Hence this monobasic acid, $C_{17}H_{14}O_4$, is an oxyisopropyldiphenyleneketonecarboxylic acid—

$$OC \begin{array}{l} \diagup C_6H_4 \\ \quad\;\; | \\ \diagdown C_6H_2 \end{array} \begin{array}{l} \diagup C_3H_6(OH) \\ \\ \diagdown CO_2H, \end{array}$$

and the retenequinone is methylisopropylphenanthraquinone. That the two side-chains are present in the same benzene nucleus is shown by the fact that the diphenyleneketonedicarboxylic acid produced by the oxidation gives a colouring matter allied to fluorescein on heating with resorcinol, and hence contains its CO_2H groups in the ortho position to each other. Hence retenequinone has the constitution—

$$\begin{array}{l} OC-C_6H_4 \\ \;|\quad\;\; | \\ OC-C_6H_2(C_3H_7)(CH_3), \end{array} \quad \text{and} \quad \underset{\text{retene}}{} \begin{array}{l} HC-C_6H_4 \\ \;\|\quad\;\; | \\ HC-C_6H_2(C_3H_7)(CH_3). \end{array}$$

—A. G. G.

Improvements relating to the Distillation of Substances containing Nitrogen, and Apparatus therefor. H. H. Lake, London. From C. Brison, Macon. Eng. Pat. 11,449, August 19, 1884.

This specification describes an improved apparatus for the production of ammonia and ammonium salts from nitrogenous substances, and which will be understood from the annexed illustration. A (Fig. 2) is a furnace with a return flue A^1 round the retort B, which has a diaphragm B^1, causing its contents to circulate twice the entire length. Above is a heater B, connected to A by two tubes, one of which is F, connected with the perforated tube F^1. M is the feed tube from an overhead supply vessel. The heater is filled with the liquid under treatment, which overflows into the retort B. The volatile ammonia is driven off from the liquid in B, and passing through F^1 is condensed for a time in the liquid in B, but as soon as the temperature is high enough it is again given off and led away to a condensing vessel. The flow of liquor is regulated so as to be continuous, and in passing from the retort is led through a vessel containing lime, and sealing the interior of the retort from the air by means of a hydraulic seal. The remaining part of the non-volatile nitrogenous matter is here decomposed, the vapour following the course already indicated. A continuous stream of lime water

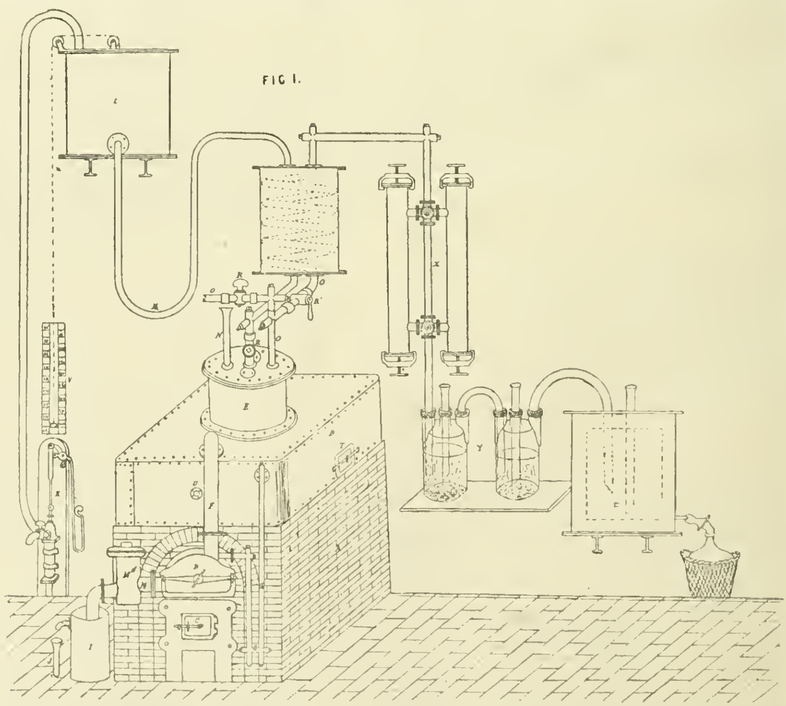
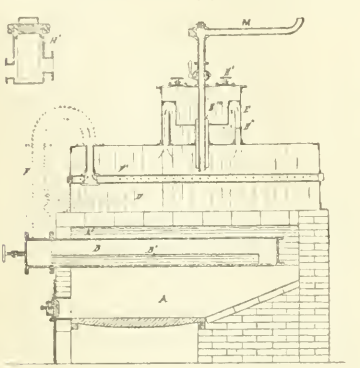


FIG. 1.

may also be added through the dome E, being held in E'', and overflowing through an annular tube E'''. In this case the gaseous ammonia escaping from the heater is constrained to pass in the direction of the arrows,

FIG 3 FIG 2



through the milk of lime in E² before leaving the apparatus. The patentee claims (1) the apparatus described, (2) the continuous treatment of nitrogenous liquids by such apparatus.—C. C. H.

Constitution of Thiophen. J. Thomsen. Ber. 18, 1832.

ABOUT five years ago the author, from his thermochemical researches on the theory of benzene, arrived at the conclusion that the six carbon atoms are combined together by nine single bonds (*Ber.* 13, 1808). Further investigations on aromatic compounds, such as toluene mesitylene, aniline, anisoïl, phenol and phenyl chloride, fully confirm the constitution of benzene, as deduced from the determination of the heat of combustion. Similar investigations on the heat of combustion of thiophen also point to the conclusion that this substance contains no double bonds, the four carbon atoms being combined together by five single bonds.—D. B.

Synthesis of Benzene Derivatives from Potassium Carboxide. Nietzki and Benckiser. Ber. 18, 1833.

THE authors have obtained Gmelin's croconic acid, $C_5H_2O_5$, from quinone derivatives. In repeating Lerch's experiments on the preparation of trihydrocarboxylic acid, dihydrocarboxylic acid and carboxylic acid from potassium carboxide hexhydroxybenzene, tetrahydroxyquinone and dihydroxydiquinoylbenzene were obtained. The authors conclude that these compounds are identical with the bodies described by Lerch. They have also established the identity of Will's rhodizonic acid with their dihydroxydiquinoyl.—D. B.

Presence of Paraxylene in Galician Petroleum. B. Pawlewski. Ber. 18, 1915.

THE author has isolated paraxylene from Galician petroleum (from Kleczany). He found that the crude oil contained about 2 per cent. of aromatic hydrocarbons, consisting mainly of benzene and paraxylene. The presence of the latter was detected by brominating the fraction distilling between 125° and 145°. Crystals of paraxylene bromide, $C_6H_4(CH_2Br)_2 = 1:4$, were obtained melting at 145°. This is said to be the first time that paraxylene has been detected in petroleum.
—D. B.

Improvements in the Distillation of Coal Tar and other Hydrocarbon Substances, and in the Apparatus employed therein. H. W. Fenner, Blackheath. Eng. Pat. 13,629, October 15, 1884.

THIS invention consists in the application of stirrers as well as steam for the distillation of coal tar, the object being to effect the distillation with greater economy and rapidity, prevent destruction of the stills and save fuel. The still is provided with a hollow shaft which forms a channel down the centre for the supply of steam, and carries branch pipes for distributing the same. This central pipe, with its branches, is made to rotate by means of suitable gearing.—D. B.

An Improved Method of Heating Substances for the Purpose of Distillation. B. Walker, Birmingham. Eng. Pat. 13,650, October 16, 1885.

DISTILLATION is effected by passing through the substance operated upon, a current of heated gas or vapour, which will not injure the distillate, or preferably it may be a portion of the vapour given off by the substance treated.—C. C. H.

IV.—COLOURING MATTERS AND DYES.

The Technology of Mineral Colours. Carl Otto Weber. Chem. Techn. Central. Anzeiger.

CHROMIUM COLOURS.

THE most important is chrome yellow, which is also the basis of chrome yellow green, cinnabar green and other similar colours. The preparation of chrome yellow presents difficulties in practice, because products differing in shade and structure, although of uniform chemical composition, are obtained according to modifications of the method of manufacture or nature of materials employed. A special difficulty is the turning of colour, by which a "turned" yellow has a dirty orange-yellow colour, which when mixed with barytes gives a yellowish-brown, leather-coloured shade and not a light pure yellow, and other derived colours are similarly affected. The acetate and nitrate of lead are the soluble lead salts generally used. Basic carbonate of lead (white lead) is also much used, the yellows prepared from this material being cheaper, having a large covering capacity and are particularly adapted for ordinary greens; but these have not the smoothness and lightness so much prized in some of the yellows obtained from soluble lead salts. The oxide, sulphate, and chloride of lead have been proposed for the manufacture of chrome yellow, but their treatment would be very tedious and the products obtained only of medium quality. In the manufacture of chrome yellow from acetate of lead and bichromate of potash, different proportions of these materials are given by different authorities, but some of these are obviously wrong where an excess of bichromate is to be used, for every light chrome yellow is liable to turn by the action of chromic acid or a chromate and thereby become of little value. Proportions should be used, whereby the acetate of lead remains in excess, and the reaction should take place in a solution as cold and dilute as possible. In this way a brilliant yellow tint is obtained. For the lighter chrome yellows, lead sulphate is precipitated simultaneously with the chromate by adding sulphuric acid or a soluble sulphate to the solution of the bichromate; these yellows have less tendency to change colour than the pure chromate of lead, if the above precautions are observed. Chrome yellow, precipitated from an excess of a lead acetate solution, by means of potassium bichromate, corresponds to the formula $PbCrO_4$. When dried it forms light pieces, which show a conchoidal fracture. A still more voluminous product corresponds to the formula $PbCrO_4$, $Pb.SO_4$. The yellow having the composition $PbCrO_4$, $2PbSO_4$, is very heavy and shows a smooth fracture. Lightness is often imparted to chrome yellow by the addition of magnesium carbonate. Nitrate of lead offers no advantages over the acetate and is generally more expensive to use. Free nitric acid is more objectionable than free acetic acid, because it may act as a solvent on chrome yellow and liberate free

chromic acid, which is liable to "turn" the yellow. When using lead nitrate it is preferable to neutralise potassium bichromate with soda to avoid the presence of free nitric acid. The yellows mostly in demand are the inferior qualities, prepared by mixing pure chrome yellows with white mineral matters, generally barytes, gypsum and kaolin, usually stirred in with the bichromate solution before adding the lead salt. Barytes injures the colour least, but kaolin has the advantage that it does not increase the weight of the colour so much. Gypsum occupies an intermediate position, it is much more voluminous than barytes and does not injure the colour so much as kaolin, but it is generally used together with barytes. It is not advisable to use this combination, for the reason that the colour on drying forms very hard pieces, which offer difficulties in grinding. Gypsum too, from being more easily acted on by reagents than barytes or kaolin, tends to take part in the reaction by decomposing the potassium bichromate before the addition of the lead salt, and this is objectionable.—G. H. B.

The Tannins and Derivative Colouring Matters (Artificial). O. N. Witt. Chem. Ind. 1885, 100—105.

THE tannins form a well-marked group of aromatic compounds which, from the circumstances of their occurrence in nature, are destined to attract much attention from those who pursue chemistry as a branch of natural history. The author, in this paper, traces the constitutional connections which have hitherto been established between these compounds and the artificial aromatic colouring matters, and the view he gives has, therefore, an additional technical interest, foreshadowing, moreover, an extended application of the tannins in the future to the production of such compounds. The older classification of the tannins on the basis of their reactions with iron salts has been re-enunciated by Watts as the exact correlative of the constitutional relationship established by his researches—*i.e.*, the tannins giving a green colouration with solutions of the iron salts are all derived from pyrocatechol; those giving a blue reaction are, on the other hand, derivatives of pyrogallol. The typical representatives of the former are the tannin acids of catechu and the oak bark; of the latter the tannin of oak galls; while in the kinoin of Malabar kino, which has been shown to be a guaiacol gallate, we have a representative of a group of intermediate compounds, constructed upon a mixed type.

The best-known tannin, or ordinary "tannic acid," is closely related to the trihydric phenol pyrogallol $C_6H_3\overset{1,\,2,\,3}{(OH)_3}$ and more directly to gallic acid, $C_6H_2\overset{1,\,2,\,3}{(OH)_3}\overset{(4)}{COOH}$. Tannin, in solution, in contact with alkalis, absorbs oxygen from the air, and is converted into tannoxylic acid, or into tannomelanic acid at the boiling temperature. Treated in acetic acid solution with nitroso-compounds, it yields colouring matters, with nitrosodimethylaniline, *e.g.*, a violet. By the action of certain acids it is converted into ellagic acid, a carboxyl derivative of a hexa-hydroxydiphenyleneketone, $C_6H(OH)_3 : CO : C_6(OH)_3(COOH)$. The constitution of this body, together with its characteristic colour reactions, indicate its probable wide application to the synthetic production of colouring matters, so soon as it can be made commercially available.

The relationship of tannin to gallic acid has been established by the well-known researches of Schiff. The conversion of gallic acid by the action of dehydrating agents into rufigallic acid or hexa-hydroxyanthraquinone, is thus expressed by the author:—

$$C_6H(OH)_3{<}\begin{matrix}H \\ COOH\end{matrix} + \begin{matrix}OH.CO \\ H\end{matrix}{>}C_6H(OH)_3 - 2H_2O$$

$$= (OH)_3.HC_6{<}\begin{matrix}CO \\ CO\end{matrix}{>}C_6H(OH)_3.$$

By the regulated action of sodium amalgam, Widmann has succeeded in converting rufigallic acid into alizarin, but the result remains for the present of purely theoretical interest. Gallic and benzoic acids treated together with concentrated sulphuric acid, are condensed to trihydroxyanthraquinone or anthragallol, a very serviceable colouring matter. Gallic acid reacts with nitroso-compounds to form colouring matters, which are the gallocyanins patented by H. Köchlin. These are fixed by means of chrome mordants. The following is an excellent formula for printing in these colours:—

75 gr. wheat starch,
$\frac{1}{2}$ litre gallocyanin paste,
$\frac{3}{8}$,, tragacanth,
$\frac{1}{8}$,, pyroligneous acid 7° B.,
$\frac{1}{8}$,, Turkey-red oil,

are boiled together, stirred till cold, and mixed with $\frac{1}{8}$ litre chromium acetate (20° B.) and 30grm. yellow prussiate. This mixture is printed and steamed in the usual way.

Pyrogallol, the phenol basis of these tannins, is technically interesting from its condensation, with phthalic anhydride, to the well-known colouring matter gallein. From the analogy of its formation, this body was supposed to be a dihydroxy-derivative of fluorescein until the researches of Buschka established for it the following constitutional formula:—

$$\begin{array}{l} \qquad\qquad\quad\;\; C_6H_2(OH)—O \\ C_6H_4 — C{<}\qquad\qquad\quad\;{>}O\;| \\ \;\;|\qquad\;\;|\quad\;\; C_6H_2(OH)—O \\ \;OC — O \end{array}$$

By dehydration with sulphuric acid, gallein is converted into cœrulein, $C_{20}H_8O_6$, a derivative of phenylanthracene, yielding this hydrocarbon on distillation with zinc dust. The following formula for preparing this colour for printing has been found to give excellent results:—600grms. of the commercial cœrulein (paste) are mixed with 320 grms. sodium bisulphite solution at 30° B., the mixture allowed to stand 3 hours, and then intimately mixed with 120grms. chrome acetate (10° B.) and 3kilos. thickening, previously incorporated together. The thickening is composed of the following: 80grms. wheat starch, 80grms. light gum, 400grms. tragacanth (jelly), 800grms. water, 200 olive oil. These are boiled for half-an-hour, stirred till cold, and the mixture strained.

The condensation products of pyrogallol with aldehydes, investigated by Baeyer, have not yet received any technical application. Another interesting derivative of pyrogallol is the nitro compound obtained by treating the phenol in ethereal solution with nitrous acid; this is converted by reduction into amidopyrogallol, which gives a blue colouring matter on treatment with solution of sodium hydrate. Pyrogallol treated with diazobenzene nitrate yields an orange-yellow colouring matter.

The colour reactions of the second group of tannins, derivatives of pyrocatechol, are, as so far established, much less numerous. The constitutional relationships of these derivatives are also much more difficult of investigation. The catechols are converted by oxidation with chromic acid into brown colouring matters. With nitroso-compounds they yield violet colouring matters, as do also machromin, the tannin and morin, the colouring matter obtained from *morus tinctoria*, and the tannin of the horse chestnut.—C. F. C.

Pentamethylamidobenzene. A. W. Hofmann. Ber. 18, 1821.

THE author gives the following method for the preparation of pentamethylamidobenzene:—2 parts of methyliodide are slowly added to 1 part of cumidine, and the reaction is completed on the water bath. On the addition of water, methyl- and dimethyl-cumidine dissolve, and also any unchanged cumidine in the form of hydriodides, and by adding alkali the bases separate out. The mixture boiling between 220° and 230° is again heated with an equal weight of methyliodide in a closed tube for 8 hours to 240—250°. The product, a dark-coloured crystalline mass, contains resins, hydrocarbons (chiefly hexamethylbenzene), and pentamethylamidobenzene, with other bases in the form of hydriodides. The mass is treated with steam, which drives off the hydrocarbons. It is then filtered and saturated with caustic soda to free the bases. A crystalline mass and an oily substance separate, the latter

being dissolved by washing repeatedly with aqueous alcohol. The crystalline compound thus purified is re-dissolved in HCl and precipitated with caustic soda, when a solid base separates, which may be re-crystallised from alcohol. The ultimate analysis of the compound and that of the platinum salt correspond to the formula for pentamethylamidobenzene, $C_{11}H_{17}N$ or $C_6(CH_3)_5NH_2$. M. pt. = 151° to 152° and b. pt. 277°—278°, the reaction taking place according to the following equation :—

$$C_6H_2(CH_3)_3N(CH_3)_2.HI = C_6(CH_3)_5NH_2.HI.$$

By the further action of methyliodide on pentamethylamidobenzene, the methylated amine may be prepared. The dimethylated compound, however, could not be obtained in this way. From this base the author has prepared the corresponding isonitrile by the action of chloroform, and also the nitrile, the latter being characterised by its stability in presence of mineral acids. By the action of KNO_2 on the amine, pentamethylphenol is obtained in white needles, and by heating the base with CS_2 the corresponding mustard oil and sulpho-urea may be prepared.—J. B. C.

Derivatives of Thiodiphenylamine. N. Fraenkel. Ber. **18**, 1843.

In a previous paper (*Ber.* **17**, 2857) it was shown that, by the introduction of one amido group into thiodiphenylamine, the leuco base of a dye is obtained. The author has continued his investigations and has prepared the following derivatives :—*Benzoylthiodiphenylamine* $C_6H_5—CO—N(C_6H_4)_2S$, obtained by heating thiodiphenylamine with an equivalent quantity of benzoyl chloride in a sealed tube at 100°. It crystallises from alcohol in the form of laminæ and from glacial acetic acid, benzene or petroleum spirit in flat needles melting at 167°. *Thiodiphenylurethane*, $S(C_6H_4)_2N—CO.OC_2H_5$, obtained by heating thiodiphenylamine with chloro-carbonic ether and ethyl alcohol to 100—120°. It crystallises in white silky laminæ melting at 109—110°. *Thiodiphenylcarbonylchloride*, $S(C_6H_4)_2N—CO.Cl$, prepared by heating thiodiphenylamine with an excess of carbonylchloride (dissolved in toluene) in a sealed tube at 100°. Crystallises in thick clusters of prisms or needles melting at 167·5°. *Dithiotetraphenylurea*, $CO(NC_{12}H_8S)_2$, obtained by heating thiodiphenylcarbonyl chloride with thiodiphenylamine (diluted with benzene) in sealed tubes to 200°. It crystallises in fine colourless laminæ melting at 223—225°. The author has studied also the action of concentrated sulphuric acid on thiodiphenylamine. A phenolic dye of the formula $C_{12}H_7NSO_2$ is obtained, called *thionol*. Its constitution appears to be

$$N(C_6H_3)_2SO(OH).$$

—D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improved Process and Solution or Liquid for treating Textile and other Materials, whereby they may be rendered Waterproof. Alfred Julius Boult. From Otto Hiller. Eng. Pat. 14,725, November 7, 1884.

The solution is prepared by adding a solution of acetate of lead to one of sulphate of alumina in such proportion that a slight excess of sulphate of alumina remains in solution. The precipitate of sulphate of lead is removed by filtration, and to the solution of acetate of alumina, a solution of albumen is added and, if necessary, the liquid again filtered. The material to be rendered waterproof is saturated with this solution, dried and passed through hot rollers to coagulate the albumen. Certain precautions are necessary, such, for example, as the employment of pure chemicals.—E. J. B.

The Manufacture and Application of a Novel Product Impervious to Air and Water. Ernest de Pass. From Albert Lèbre. Eng. Pat. 15,075, November 15, 1884.

In working out a process for waterproofing fabrics, patented in 1883, November 5, No. 5242, it was discovered that a combination is effected between cotton or similar substances and the waterproofing material employed. The compound so formed has been called by the inventor "Hydrofuge Cotton." It has many useful industrial applications.—E. J. B.

Improvements in the Preparation and Utilisation of Peat Fibre for Textile Purposes. William Phillips Thompson. From George Henri Béraud. Eng. Pat. 15,877, December 3, 1884.

The preparation of the raw material is effected by scutching and carding the peat by machines similar to those used in the preparation of other fibres; the dark colour of the material may be got rid of by the use of bleaching agents in the usual way.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Artificial Alizarin in Wool Dyeing. The St. Denis Dyes and Chemical Products Company. Chem. Zeit. 1885, 926, 927.

The artificial product dissolves in the bath just as the wool takes it up, so that the operation requires no more time than is needed by the dye as generally used. By merely changing the mordant and its relative amount a large number of shades can be produced. Thus with aluminium salts can be obtained shades from delicate rose to deep red; with chromium salts from light wine colour to dark chestnut-brown; with iron salts from light lilac to dark violet; with uranium salts from a greyish blue to dark slate; with nickel salts from greyish lilac to bluish garnet, with tin salts from rose to deep red, etc. Fustic and cœrulein dye with the same mordants and add to the number of colours which can be attained by the help of alizarin. Dyeing by means of alizarin is effected in two stages; first, the mordanting, and then the dyeing proper. The former is done at a boiling temperature and takes from 1—1½ hours. After being washed in running water the dyeing proper follows.
—J. T.

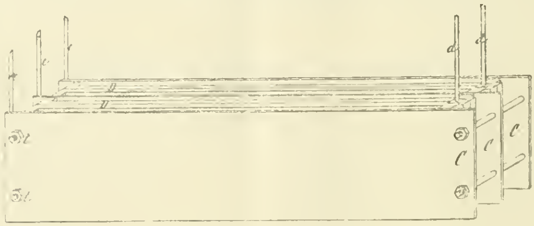
Improvements in Machinery for Printing in Colours. A Grafton, London. Eng. Pat. 14,876, November 11, 1884.

The inventor describes with great fulness of mechanical detail a polychromatic printing machine which he has devised, "capable of printing on large surfaces and free from any irregularities of motion which would cause imperfect impressions."—J. H. H.

Improvements in Bleaching and Apparatus therefor. J. H. Johnson. From E. Hermite, Paris. Eng. Pat. 13,929, October 21, 1884.

This invention relates to an improved process and apparatus for bleaching yarn, textile fabrics, paper pulp, etc., by means of the electrolytic decomposition of magnesium or calcium chloride—preferably the former. The reactions which ensue when a solution of $MgCl_2$ is submitted to electrolysis are extremely complex, and the inventor gives several equations—though unfortunately he uses the old notation—showing that chlorates, chlorites and hypochlorites are formed and that the action is continuous, $MgCl_2$ being the final product. Hence the same solution can be used an indefinite number of times. A solution of $MgCl_2$ of sp. gr. 1·125 (25° T.) gives the best results; with $CaCl_2$ a sp. gr. of 1·191 (38° T.) is required. The inventor states that he has shown experimentally that, in order to bleach linen thread, the quantity of chlorine required is only about one-ninth of that required by the ordinary bleaching powder method. The negative electrodes consist of zinc plates bolted together and soldered to copper rods which are connected with the main conductors, and insulated by means of varnish from contact with the liquor. The positive electrodes are platinum plates sunk into wooden frames and similarly soldered to copper conducting rods. In the figure annexed C C are the zinc plates; D D the platinum plates, and *c c* and *d d* the copper conducting rods, while through the holes

t t pass the bolts joining the zinc plates. Various methods of applying the process to cotton goods, yarn and paper pulp are described; in the case of the last-mentioned the electrolysed solution must be run off as soon as the bleaching is completed. The specific resistance of a solution of $MgCl_2$ of sp. gr. 1·125 at 30° C. is 6·1 ohms, and the polarisation in open circuit 2·13 volts. The inventor claims that the most delicate textiles are not in the least injured by the use of his process of bleaching.—J. H. H.



VII.—ACIDS, ALKALIS, AND SALTS.

Cause of Decrepitation in Samples of so-called Explosive Pyrites. B. Blount. J. Chem. Soc. August, 1885, 593.

The author found that these decrepitations were due to the presence of confined carbonic dioxide and water, but the CO_2 and H_2O did not occur in any definite ratio to each other, one sample being quite free from moisture. The particular pyrites examined was copper pyrites from the Cosheen Copper Mine on Scull Harbour, County Cork. —F. L. T.

Improvements in the Manufacture of Salt from Brine, and in Apparatus therefor. H. Whitehead and R. Hodgson, Sandbach. Eng. Pat. 14,533, Nov. 4, 1884.

This invention consists in a greatly improved system of evaporating, and in apparatus for carrying it into effect. The liquor to be boiled down is alternately heated to the boiling point and then allowed to cool, the crystals being meanwhile fished out. The cold mother-liquor is again heated, cooled, and so forth, until all is evaporated. In actual practice the process becomes continuous by dividing the pan into a series of troughs, communicating alternately at each end, sending the hot liquor in at one end and pumping the cool out at the other for reheating. The apparatus consists of two cylinders containing a series of pipes through which the brine is made to pass by means of a pump. The upper cylinder is supplied with steam from the boiler, the lower cylinder being heated by the exhaust steam of the pump. The brine in passing through the pipes becomes heated to its boiling point, then flows into a pan, where it cools down and deposits salt, and afterwards flows continually through an overflow into a tank, from which the pump passes it into the pipes and into the pan as before. The tank is automatically supplied with new brine. The salt is drawn from the pan by a mechanical scraper. As no heating of the pan is required, it can be built of cement, and consequently the wear and tear incident on heating brine-pans by firing below, is avoided.—S. H.

Improvements in the Manufacture of Alkaline Phosphates. P. M. Justice, London. From L. E. Thomas, Paris. Eng. Pat. 14,549, November 4, 1884.

An intimate mixture of an alkaline chloride and caustic alkali is exposed to the action of molten phosphoric iron in a converter, preferably having a basic (Thomas & Gilchrist) or neutral lining. Carbonate of soda or potash, or magnesia or oxide of iron are added to the mixture to diminish its volatility. At the end of the operation the slag will contain the phosphorus from the metal as an alkaline phosphate, more or less soluble in water. The slag may be subsequently fused with alkaline carbonate, hydrate or sulphate, to render the whole of the phosphoric acid soluble in water.—S. H.

Improvements in the Treatment of Sulphate of Iron. S. Callard, Carmarthen. Eng. Pat. 15,393, November 22, 1884.

This invention relates to improvements in the drying of sulphate of iron previous to its being placed in the muffle, as described in Letters Patent 5930, April 4, 1884, for "Improvements in the destructive distillation of sulphate of iron, and in the obtaining therefrom of sulphurous acid and red oxide of iron." For the purposes of this invention the sulphate of iron is heated in iron pans along with a certain amount of sulphuric acid, which prevents the formation of scale and brings the whole charge in a pulverised condition when dry.—S. H.

Improvements in Treating Salt, etc. A. Collingridge, London. From V. Cornet and A. Jones, Paris. Eng. Pat. 5706, May 9, 1885.

Unsuited for abstracting.—C. C. H.

Obtaining Liquid Anhydrous Sulphurous Acid from Furnace and other Gases. E. Haenisch and M. Schroeder, Oberhausen, Prussia. Eng. Pat. 6405, May 26, 1885.

The object of this invention is to obtain anhydrous sulphurous acid from gases containing only a small percentage of sulphur dioxide. The process may be divided into three distinct stages. 1. The production of watery sulphurous acid solutions by bringing furnace gases in contact with a stream of cold water. 2. The production of pure sulphur dioxide by heating the sulphurous acid solution. 3. The condensation of sulphur dioxide by compression or refrigeration. The gases from the roasting kiln pass through a pipe into an absorbing tower, charged with coke, where they are met by a copious spray of cold water. The solution thus formed flows into a series of closed pans, made of sheet lead, to which heat is applied. The sulphur dioxide evolved passes into a cooling worm, and then for removing the last traces of water into a vessel charged with pieces of calcium chloride, and thence to a compression pump. The water from the pans is deprived of the last traces of sulphurous acid by allowing it to pass through a tower filled with lead-wire network, where it meets steam at the bottom. The pressure within the apparatus is regulated by means of a taffeta bag, the working of the pump being regulated by the dimensions it may assume for the time being. The gases compressed by the pump are cooled by the worm and condensed in the receiver, whence the liquid sulphurous acid may be drawn off for use.—S. H.

Improvements in Decarbonating the Carbonates of Strontia and Baryta, and in Apparatus therefor. Abel and Imray, London. From H. Leplay, Paris. Eng. Pat. 8541, July 14, 1885.

The invention refers to a former specification, No. 9765, July 4, 1884, where the decomposition of the carbonates

of strontia and baryta by means of superheated steam was described. The mode of proceeding has now undergone several alterations. The steam is not brought in contact with the carbonate until the latter has been raised to a sufficiently high temperature to cause its immediate decomposition. For this purpose the kiln is heated by producer gas, containing carburetted hydrogen, which, on entering into combustion, produces steam heated to a high degree, which assists in the decomposition of the carbonate. In order to obviate fluctuations in the decomposing kiln, the carbonate previous to entering the furnace is dried in a muffle, heated by the hot waste gases of the kiln. Baryta treated in this manner is reduced to a molten mass, which offers an insufficient surface to the action of the steam. The inventor, therefore, introduces into the lower part of the kiln basic aluminous or magnesian perforated blocks, which are not attacked by the molten monohydrate, and which cause the latter to flow downward in a subdivided state while subject to the action of steam.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in Machines for Making Pottery, Glassware, and Articles of all kinds, from Soft Plastic Materials which are capable of being moulded. C. C. Thompson, of East Liverpool, Columbiana County, Ohio, U.S.A. Eng. Pat. 7937, June 30, 1885.

THE object of this invention is to provide a machine for forming articles having both straight and curved surfaces from clay, glass, paper pulp, and similar plastic materials—which are capable of being moulded—and to so construct the parts to which the shaping tools are secured that the tools will have both a reciprocating and downward and upward lateral movement in forming the article which is being made, for the purpose of preventing the material which is being shaped from being injured at its bottom by the shaping tools as they are drawn backwards after having been moved laterally for the purpose of forming the swell or concavo-convex in the article. Detail drawings are furnished.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

An Improved Process for the Manufacture of Asphalt. H. Kettman, Brunswick. Eng. Pat. 12,425, September 15, 1884.

THE methods ordinarily used for the manufacture of asphalt do not result in the production of a sound and homogenous material, because the bituminous bodies used do not become so intimately incorporated with the limestone, etc., as they should do. The author proceeds as follows:—Crude bitumen is heated with hydrocarbon oils; the clayey matter is deposited. The quantity of oil used is such that at a temperature of 17° C. to 33° C. the bitumen should be capable of being drawn into threads. Limestone or asphalt stone is finely powdered and mixed with about 40 per cent. of water, forming a thin cream; 15 per cent. of the bitumen at a temperature of 70° C. is then added and the whole well incorporated. The suspension of the stone in water provides a condition under which it may be properly and thoroughly coated with bitumen. The temperature is raised to such a point that the water is finally expelled. The liquid mass is then cast into blocks and is ready for use.—C. C. H.

The Manufacture of Waterproof Cement. W. Smith, Dublin. Eng. Pat. 13,355, October 9, 1884.

EQUAL weights of finely-powdered limestone and pitch are intimately mixed. The resulting product may be used as a cement for binding together building materials or as a waterproofing material in building works. It may also be used in combination with other materials for the manufacture of waterproofing materials. —C. C. H.

A New or Improved Fibrous Fireproof and Waterproof Composition for Constructive, Decorative, and other Purposes. W. Millar and C. F. Nichols, London. Eng. Pat. 2927, March 5, 1885.

THIS material is to be applied for decorative purposes and as a substitute for papier maché, wood, etc. A mixture of powdered brickdust, pumice stone, slag wool and Portland cement is moistened with an aqueous solution of carbonate of soda and ammonia, caustic soda, chloride of magnesium or bittern water; to impart strength or flexibility, the plastic mass is applied to wire work or perforated metal, or incorporated with tow and rendered fireproof by immersion in a solution of borax, and if hardness is required, steeped in a solution of calcium chloride and a subsequent bath of silicate of soda, and finally washed in bichromate of potash.—C. C. H.

An Improved Metallic Compound for Flooring, Paving, and other Purposes. C. A. Wilkes and W. Millar, London. Eng. Pat. 7148, June 11, 1885.

THE improved compound when used as flooring does not become slippery or soften in hot weather, and sets rapidly. Blast furnace slag is broken to a fine powder and washed; if a striking colour be desired the product is mixed with oxides of iron. To three parts of slag one part of hydraulic cement is added and sufficient water, which contains in every gallon one part of bittern water, 5 per cent. of carbonate of soda, 2·5 per cent. of carbonate of ammonia, a little potash, and if rapid hardening is desired 1oz. of calcium sulphate is added to every gallon of water.—C. C. H.

X.—METALLURGY, MINING, Etc.

The Co-operation of Water in the Slow Oxidation of Zinc, Lead, Iron, and Hydrogenised Palladium. M. Traube. Ber. **18**, 1877.

THAT water assists the oxidation of the non-precious metals by air is well known, but the part played by the water has not been studied, it being taken for granted that the metals unite directly with the oxygen of the air, forming oxides. The author was the first to show that the phenomena accompanying this oxidation can only be explained by the splitting up of the water molecule (*Ber.* **15**, 663).

If metals unite with free oxygen, oxides will be produced; but should hydroxides be produced, it would be a proof that water enters into the reaction. The author finds that in the case of zinc, lead, and iron, hydroxides are produced. Further, if the water took no part in the reaction, the oxidation of these metals should take place equally well with any other liquid in presence of air—*e.g.*, absolute alcohol. But on trying, there was found to be no oxidation; alcohol diluted with water, however, did cause oxidation.

The hydrogen occluded by palladium possesses in a high degree the property of combining with the atmospheric oxygen at the ordinary temperature, and on exposing a piece of palladium foil highly charged with hydrogen, to the air, its hydrogen combines with the atmospheric oxygen so rapidly that the foil becomes red-hot. It was found that hydrogenised palladium when covered with absolute alcohol and exposed to air did absorb oxygen, but as it was in this case impossible to be certain that every trace of water was absent on starting the experiment, and the product of oxidation also being water, it is easy to see that a trace of water in starting would be capable in a short time of producing a large quantity. The author found that hydrogenised palladium placed under strong sulphuric acid did not absorb oxygen, but that it did so on diluting the acid. He obtained a similar result on using a syrupy solution of pentoxide of phosphorus as his drying agent. The author has found that neither zinc, lead, iron, nor hydrogenised palladium will act on water free from air at the ordinary temperature. The action of zinc on water and oxygen can be represented: $Zn + 2OHH + O_2 = Zn(OH)_2 + H_2O_2$, and confirming this equation, it is found that hydrogen peroxide is produced. This also shows the

true nature of peroxide of hydrogen, which is to be regarded not as a higher oxide of hydrogen, nor as an oxidation product of water, but as a combination of an oxygen molecule. Lead and hydrogenised palladium also produce hydrogen peroxide on oxidation. The hydrogen peroxide produced in this manner cannot occur in large quantities, because the metals and the hydrogen are capable of reducing it again.

The author concludes that as nascent oxygen destroys hydrogen peroxide, the presence of hydrogen peroxide in these experiments shows that no nascent oxygen could have been present.—F. L. T.

Improvements in Metallurgy. Dingl. Polyt. J. **256**, 506—573.

Crucible Steel. F. C. G. Müller.—For refined steel the crucible process is indispensable. In an Austrian establishment the graphite used for crucible making in the following experiment consisted of carbon, 75 per cent.; silica, 13; alumina, 8; iron oxide, 1·8; lime, 0·2; and water, 2 per cent. The clay used contained silica, 50·1 per cent.; alumina, 33·6; iron oxide, 2·8; potash, 3·2; magnesia, 0·5; and water, 10·1 per cent. The crucibles were charged with 20 to 30kilos., and were heated in a Siemens furnace, with others, in the ordinary course of work; hard steel fusions were heated five hours; soft steel, six hours. In a crucible made of three parts graphite, and 3·25 parts clay, the following fusions were made:—

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
C	3·593	3·709	3·773	3·636	0·939	1·193	1·268	0·018	0·251	0·350
Mn ..	2·038	1·910	1·856	1·861	0·210	—	0·224	0·083	—	—
Si ..	0·075	0·578	0·765	1·069	0·021	0·358	0·628	0·021	0·081	0·257
P	—	—	—	—	0·012	—	—	0·041	—	—

Number (1) is soft Styrian pig iron; (2) is the same once melted in the crucible; (3) is twice melted, and (4) is three times melted. Number (5) is raw refinery steel; (6) is the same once melted, and (7) is twice melted. Number (8) is refinery bar iron; (9) is the same once melted, and (10) is twice melted. The ingot (9) was full of blow-holes, whilst that of (10) was quite sound. In the two following experiments—*i.e.*, analyses (11)-(16), inclusive—with crucibles of five parts graphite to one part clay, the upper part of the crucibles became perforated, so that furnace-gases had access to the contents. Later, two new experiments were made, in which only the lower part of the crucible was made of five parts of graphite to one of clay, the upper part being of the ordinary mixture—1 : 1. These pots remained sound.

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
C ..	0·915	1·130	1·150	0·018	0·720	0·675	0·910	1·308	1·623	0·010	0·671	1·336	1·125	1·118	1·106	0·090	0·321	0·390
Mn..	0·211	—	0·192	0·111	—	0·091	0·110	0·565	0·738	—	—	—	0·179	—	0·111	0·093	—	0·101
Si ..	0·031	0·313	0·622	traces	0·290	0·621	0·019	0·203	0·350	0·023	0·302	0·658	0·023	0·350	0·609	0·019	0·202	0·393

Number (11) is raw refinery steel; (12) is the same once melted; (13) the same twice melted. The crucible, as remarked above, burnt through in its upper part. Number (14) is refinery bar iron; (15) is the same once melted, and (16) twice melted. Ingot (15) was porous, whilst (16) was sound. The crucible burnt through above. Number (17) is raw refinery steel; (18) is the same once melted, and (19) the same twice melted. The crucible remained sound, as remarked above; its upper part being composed of one part graphite to one part clay. With (18) and (19), one per cent. of manganese oxide was placed in the crucible with each charge. Number (20) is refinery bar iron; (21) the same once fused, and (22) twice fused. As in the previous experiment, the crucible remained sound. Ingot (21) was blown; (22) was sound. Number (23) is raw refinery steel; (24) the same fused in a new English plumbago pot; (25) the same twice fused. Number (26) is refinery bar iron; (27) is the same once fused in a once-used English plumbago crucible; (28) the same twice fused. Both ingots were blown.

In graphite crucibles of the ordinary make, as well as of those richer in graphite, both hard and soft steels take up about 0·3 per cent. of silicon. In crucibles of the former character, about 0·2 per cent. of carbon is taken up by the steel, whilst in the more graphitic crucibles 0·45 per cent. of carbon is absorbed at a tool-steel heat, and 0·6 per cent. at a scythe-heat. The manganese is unaffected. Manganese is reduced from oxide added to the charge, and the amount of silicon is at the same time reduced. Only the carbon is attacked when furnace gases have access to the charge. The silica present in graphite appears to be more easily reduced than that in the clay. In clay pots, practically no silicon is absorbed by the steel.

Gases in Steel. Müller thinks that the gases cannot be expelled by any purely physical process. He states that Wasum fused some Thomas-steel in a clay pot without any admixture. After three hours' heating, on casting, the ingot boiled up much more than the original metal. The metal before melting contained: Carbon, 0·015 per cent.; silicon, 0·011; phosphorus, 0·023. After melting it contained: Carbon, 0·020; silicon, 0·023; phosphorus, 0·034.

Tungsten-Iron Alloy. L. Schneider.—An alloy of specific gravity 9·306 at 17° contained: Iron, 68·36 per cent.; tungsten, 28·18; manganese, 0·99; cobalt and nickel, traces; silicon, 0·23; phosphorus, 0·01; sulphur, traces; carbon, 1·88. On boiling with hydrochloric acid a metallic powder was obtained, which could be easily separated into two portions by means of a magnet, whilst only traces of tungsten were dissolved. The non-magnetic portion, composing about ninety per cent. of the whole, consisted of light-grey, well-formed octahedra, hard enough to scratch glass, but brittle enough to be ground in an agate mortar. The amount of iron varied between twenty-four and thirty-one per cent., and the carbon between 1·4 and 1·6 per cent. The magnetic portion was dark-grey, metallic, and, under the microscope, had a frothy appearance. It contained: Iron, 68·1 per cent.; tungsten, 27·7; and carbon, 4·1.

Tungsten-steel of the following composition: Iron, 85·00 per cent.; tungsten, 11·03; manganese, 1·49; silicon, 0·26; phosphorus, 0·01; carbon, 2·15: left 13·1 per cent. of a fine non-magnetic powder on being heated with hydrochloric acid. This powder contained: Iron, 22 per cent.; carbon, 1·1; thus agreeing in composition with the crystalline powder above. On the other hand, soft steel containing tungsten, when treated with dilute hydrochloric acid (1 : 8), leaves only traces undissolved of tungsten containing iron. Carbon, silicon, phosphorus, etc., harden steel; tungsten acts similarly, but the former combine with the iron, whilst the latter remains uncombined, consequently a considerable amount of tungsten is necessary to produce a hard steel. Such a steel resists atmospheric corrosion, and damasceens beautifully, owing to the tungsten present.

Copper Refining.—W. Braun (Ger. Pat. No. 31276, May 27, 1884) proposes to pass gaseous hydrochloric acid through molten copper, with exclusion of air as much as possible. The red oxide is volatilised as chloride, and all other metals present as oxides, and all metals capable of decomposing hydrochloric acid are also removed. Very tough, compact copper results,

which has a high electric conductivity. The copper can be cast solid in moulds filled with an indifferent gas.

Oxygen in Metals and Alloys. A. Ledebur.—This should always be determined by ignition in hydrogen, as a portion is frequently present as oxide. The following amounts of oxygen were found in the various metals and alloys given: Commercial copper, 0·227 per cent.; sheet copper, 0·124; compact copper fused under common salt, 0·092; cast bronze with four per cent. tin, Royal Gun Works, Spandau, 0·070; gun bronze with ten per cent. tin, from the same works, 0·051; ancient bell metal, containing copper, 72·5 per cent.; tin, 23·7; lead, 1·8; the oxygen was 0·126 per cent.; manganese bronze from Spandau, with manganese 0·14 per cent.; iron, 1·55; tin, 5·86 per cent.; the oxygen was 0·036; phosphor bronze from the same, phosphorus, 0·004 per cent.; oxygen, 0·038; Berlin cast brass, 0·033; Vienna cast brass for sheet, 0·015; cast nickel from Pfannesteil, brittle, unmalleable, 0·304; malleable nickel from the same (without magnesium addition) in sheet, 0·084; Fleitmann's sheet-nickel (with magnesium addition) from Iserlohn, 0·095; cast German silver, 0·061.—J. T.

Slow Oxidation of Copper in Presence of Dilute Sulphuric Acid or Solution of Ammonium Carbonate. M. Traube. Ber. **18**, 1887.

THE author finds that copper is not acted on by water, either in presence or absence of air. When, however, it is in contact with dilute sulphuric acid in presence of air, or of a solution of ammonium carbonate in presence of air, it is dissolved with simultaneous production of hydrogen peroxide:—

$$Cu + SO_4H_2 + O_2 = CuSO_4 + H_2O_2$$
$$Cu + CO_3(NH_3)_2.H_2 + O_2 = Cu(NH_3)_2CO_3 + H_2O_2$$

The hydrogen peroxide does not occur in large quantities, because it is again destroyed by a secondary reaction:—

$$Cu + SO_4H_2 + H_2O_2 = CuSO_4 + 2H_2O$$
$$Cu + CO_3(NH_3)_2H_2 + H_2O_2 = Cu(NH_3)_2CO_3 + 2H_2O$$

Copper by itself in absence of air is unable to decompose either dilute sulphuric acid or a solution of ammonium carbonate.—F. L. T.

Zinc Analyses. L. Schneider and H. Peterson. Dingl. Polyt. J. **256**, 518.

	I.	II.	III.	IV.
Lead	1·1183	1·7772	1·1921	0·623
Iron	0·0280	0·0280	0·0238	0·032
Cadmium	0·0215	—	—	0·054
Copper..........	0·0002	—	0·0002	traces
Silver	0·0017	traces	0·0007	traces
Arsenic	traces	—	—	—
Antimony	—	—	traces	—
Bismuth	—	—	traces	—
Sulphur	traces	0·0020	traces	traces

I. George Works of the Silesian Union; II. The same, brand C H; III. G. v. Giesche's Estate; IV. Sagor Works.—J. T.

Influence of Silicon on the Properties of Cast-iron. Thomas Turner. J. Chem. Soc. 1885, 577.

AUTHORITIES differ as to the influence of silicon on cast-iron, the general opinion being that it is injurious. The author shows that under certain circumstances it slightly increases the tenacity of cast-iron.

TABLE A.—*Summary of Tensile Tests* (by Professor Kennedy).

U. C. L. Test Numbers.	Silicon per cent.	Breaking Load per square inch. Pounds.	Breaking Load per square inch. Tons.	Modulus of Elasticity.
8807	0	22,720	10·14	25,790,000
8118	0·5	27,580	12·31	28,670,000
8147	1	28,490	12·72	31,180,000
8116	2	35,180	15·70	23,560,000
7867	2·5	32,760	14·62	25,150,000
8115	3	27,390	12·23	21,150,000
8114	4	25,280	11·28	15,640,000
8894	5	22,750	10·16	18,720,000
7866	7·5	11,950	5·34	14,750,000
7865	10	10,630	4·75	13,930,000

TABLE B.—*Results of Analyses* (by T. Turner and J. P. Walton).

U. C. L. Test Nos	Total Carbon.	Graphite.	Combined Carbon.	Silicon.	Phosphorus	Manganese.	Sulphur.
8807	1·98	0·38	1·60	0·19	0·32	0·14	0·05
8118	2·00	0·10	1·90	0·15	0·33	0·21	0·05
8147	2·09	0·24	1·85	0·96	0·33	0·26	0·04
8116	2·18	1·62	0·56	1·96	0·28	0·60	0·03
7867	1·87	1·19	0·68	2·51	0·26	0·75	0·05
8115	2·23	1·43	0·80	2·96	0·34	0·70	0·04
8114	2·01	1·81	0·20	3·92	0·33	0·84	0·03
8894	2·03	1·66	0·37	4·71	0·30	0·95	0·05
7866	1·86	1·48	0·38	7·33	0·29	1·36	0·03
7865	1·81	1·12	0·69	9·80	0·21	1·95	0·04

The author made "pure cast-iron," and melted it with varying quantities of silicon iron, with a view to obtaining the quantities of silicon in the second column of table A. The mechanical tests were performed by Prof. A. B. W. Kennedy, at University College, London, and the results are in Table A. Table B gives the check analyses of the samples after the mechanical testing. This table also confirms the fact first noticed by Sefström, and mentioned by Percy, that in cast-iron which contains much silicon, the carbon chiefly occurs in the graphitic state.—F. L. T.

Blast Furnace Working. H. v. Jüptner. Chem. Zeit. 1885, 888—890.

THE data obtained from a week's working of a charcoal blast furnace, were as follows: Ore charged, 249,600 kilos.; iron washed from slag, 6000kilos.; limestone, 26,100kilos.; charcoal, 106,480kilos. There were produced: pig iron, 114,600kilos.; slag, 64,600kilos.; flue dust (dry), 3275kilos.; iron washed from slag, 6000kilos. Average temperature of the blast = 350° C. Blast pressure (average) 60mm. water; diameter of tuyeres, 55mm.; mean temperature of waste gases, 127° C.; average moisture in blast, 0·87 per cent. by weight; mean temperature of the air, 17° C.; mean barometric height,

710mm. The materials given above had the following composition :—

	Ore.	Lime-stone	Slag.	Flue Dust.	Char-coal.
Potash	—	—	—	0·85	0·10
Soda	—	—	—		0·06
Lime	0·92	50·08	26·25	6·35	0·79
Magnesia	4·72	0·60	16·07	3·39	0·17
Iron protoxide	20·27	—	5·56	16·59	—
Iron sesquioxide	41·18	—	—	40·50	0·01
Alumina	2·11	0·16	7·07	2·95	—
Manganese protoxide	2·80	—	3·89	2·98	—
Copper oxide	0·076	—	0·13	0·06	—
Silica	12·85	0·44	39·99	13·75	0·17
Sulphuric anhydride	0·288	0·03	1·04	0·30	0·03
Phosphoric „	0·288	0·03	0·007	0·072	0·05
Carbonic „	2·32	43·15	—	6·79	0·63
Water	12·50	1·58	—	—	10·25
Carbon	—	—	—	4·75	86·25
Nitrogen	—	—	—	—	0·52
Hydrogen (disposable)	—	—	—	—	1·01
	100·322	100·07	100·07	99·872	100·31

Pig iron :—Iron, 91·761 ; combined carbon, 0·892 ; graphite, 2·800 ; silicon, 1·800 ; sulphur, 0·018 ; phosphorus, 0·042 ; manganese, 2·650 ; copper, 0·032. The average composition of the waste gases in volumes, per cent., was : Carbon dioxide, 8·5 ; oxygen, 0·4 ; carbon monoxide, 28·1 ; marsh gas, 0·8 ; hydrogen, 7·1 ; nitrogen, 55·1. The amount of the various constituents, per 10,000 kilos. of pig iron, is calculated, and an attempt is made to balance the various items. The thermal account is balanced as follows :—

(A) Heat produced.	Heat units.		Per cent.
Carried into the furnace by the blast	3055392·2	=	9·23
Added in the charge	87127·3		0·26
Produced in the furnace	29940211·0		90·51
Total..	33082736·5		100·00
(B) Heat consumed.			
Chemical work in the furnace	16521893·5	=	49·94
Evaporation of water in the charges	2545978·8		7·69
Fusion of pig iron and slag	5743730·0		17·36
Heat lost in flue dust	24456·3		0·07
„ „ waste gases	1799230·3		5·43
„ „ by radiation and conduction	6447447·6		19·51
Total..	33082736·5		100·00

—J. T.

Ferro-Chromium Alloys. L. Schneider. Chem. Zeit. 1885, 924—925.

An alloy containing about 50 per cent. chromium dissolves at first, when warmed with hydrochloric acid, with evolution of gas. But the action is soon stopped by a coating of oily hydrocarbon which collects on the metallic particles. This hydrocarbon is formed in considerable quantity. On removing mechanically the crystalline powder obtained from the pieces of alloy, and heating, or treating with alcohol and ether to get rid of the hydrocarbon, a large portion of this can be dissolved, and in this way alloys with 66 per cent. of chromium may be dissolved. This difficultly soluble alloy consists of minute crystalline needles. It may also be obtained from ferro-chromium by treating with copper chloride, then with caustic alkali, alcohol, ether, and finally igniting in hydrogen. The crystals contain—Chromium, 66·2 ; iron, 24·9 ; carbon, 8·5 ; nearly corresponding to the formula, $Fe_4CCr_{12}C_4$.—J. T.

The Use of Explosives in Mines. Chem. Zeit. **9**, 1088.

The following notice has been issued by the authorities of the Cologne Mining Association (Bergwerksverein) :—In all workings where fire-damp occurs, blasting with gunpowder and similar slowly-exploding agents is prohibited, not only in the coal measures themselves, but also in the adjoining rock, only the use of dynamite and quickly-exploding agents like dynamite, equally inoffensive as regards coal dust, being permitted. But, blasting with dynamite is not even permitted in those parts of the workings where such accumulations of fire-damp may under ordinary circumstances collect, that the burning of the safety lamp is sensibly affected (3 per cent.).—G. H. B.

Treatment of Complex Metallic Ores or Solutions. G. I. J. Wells, Liverpool. Eng. Pat. 12,317, September 12, 1884.

The author claims the fractional precipitation and separation successively of the metals contained in complex metallic solutions, by means of decomposable sulphides added in such successive portions as shall be necessary to separate from their solutions, and from each other, the metals—copper, lead, zinc and iron. The complex solution obtained from the drainage of alkali waste is suitable as a precipitant.—J. T.

Improvements in Apparatus for the Amalgamation of Gold and Silver. George Washington Moon, Regent Street, Middlesex. Eng. Pat. 12,930, September 29, 1884.

By means of an intermittent rotary motion in a vertical plane, the mercury is forced round an oval curve, into the top of which the ore is introduced. Two or more of these curves may be arranged in series for the more efficient amalgamation of the ore. Any flour of mercury which might pass away is caught and retained in an egg-shaped cavity, over which the tailings pass before leaving the machine. Between the curve and this cavity movable amalgamated copper plates are placed.

—W. G. M.

Coating Vessels of Copper or Copper Alloys with Lead. J. S. McDougall, Chadderton. Eng. Pat. 15,800, December 1, 1884.

The surface of copper, or copper alloy, to be coated, is cleaned, and is coated with zinc chloride (or its equivalent in this application), and afterwards a coating of lead of any thickness is attached by means of heat applied in any suitable manner.—J. T.

Improvements in the Reduction of Iron or Zinc Ores. W. R. Lake, London. From G. M. Westman, Stockholm, Sweden. Eng. Pat. 15,861, December 2, 1884.

The apparatus consists of three furnaces, two heat regenerators, two air-heating chambers, suitable connecting pipes, and four valves. The furnaces have closed mouths, shafts and hearths. Two powerful blowing engines are provided, one for the gases and the other for the blast. In working zinc ores, the central furnace is charged with briquettes of calcined zinc ore and coal powder. The outer furnaces are filled with fuel only, are used alternately as condensers of zinc vapour, and as gas generators respectively. In working iron ores, the central furnace is filled with fuel only, whilst the outer furnaces are filled with fuel, ore, and fluxes as in an ordinary blast furnace. While the ore is reduced in the one outer furnace, the ore already reduced is melted in the other outer furnace. The central furnace is used to regenerate or again carburet the gases arriving from the reducing furnace.—J. T.

Smelting Sulphide of Antimony. N. C. Cookson, Newcastle-on-Tyne. Eng. Pat. 3386, March 16, 1885.

The reduction of antimony sulphide is to be effected by pouring over it molten iron. The sulphide is placed in

a ladle lined with refractory material, and the molten iron is poured over it, thus avoiding the use of crucibles. After the decomposition has been thus effected, the contents of the vessel are poured into a receiver, and after cooling the products separated in the usual way.—J. T.

Manufacture of Iron Sponge, Iron, and Steel. W. R. Lake, London. From C. J. Eames, New York, U.S.A. Eng. Pat. 6429, May 26, 1885.

IRON ore is intermingled with an impure graphite, known as "graphitic carbon," and after being heated by waste gases from the furnace, it is more strongly heated on the hearth of a reverberatory furnace. This furnace has, by preference, an improved hearth formed of friable graphitic lumps. After the ore is reduced on this hearth it is passed over to a second hearth nearer to the fire, and the spongy mass is there balled up.—J. T.

Improvements in the Manufacture of Iron Sponge, Iron, and Steel. W. R. Lake. From C. J. Eames, New York. Eng. Pat. 6430, May 26, 1885.

CLAIMS to make wrought iron direct from ores by melting the ores in a furnace having its hearth composed of a mixture of graphite, pulverised fire-brick, and coal-tar or molasses, or their equivalents. The remaining claims are substantially covered by the preceding specification. —J. T.

Improvements in the Manufacture of Iron Sponge, Iron and Steel. W. R. Lake. From C. J. Eames, New York. Eng. Pat. 6431, May 26, 1885.

THE inventor proposes the use of a stiff paste made from pulverised graphite, and an adhesive carbonaceous cement, such as tar or molasses, which paste can be readily applied as an adhesive covering to the ore. —J. T.

Improvements in the Thomas-Gilchrist Process. W. P. Thompson, London. From B. Osann, Potsdam, Prussia. Eng. Pat. 8392, July 11, 1885.

BY fusing a mixture of sodium or potassium carbonate with iron sesquioxide or manganese sesquioxide, an anhydrous refractory compound will be obtained which, when treated with water, gives a solution of caustic soda or caustic potash with separation of iron or manganese sesquioxide. If, instead of adding the usual lime flux to the Thomas converter, the above mixture be used, caustic alkalis can thus be cheaply produced, and the phosphoric, chromic, vanadic, or other acids formed in the Thomas-slag, are rendered easily soluble in water. —J. T.

Obtaining Aluminium and other Metals from their Ores. W. P. Thompson, London. From E. H. Cowles and A. H. Cowles, Cleveland, Cuyhogo Co., Ohio, U.S.A. Eng. Pat. 9781, August 18, 1885.

THE object of this invention is the reduction of aluminium from its ores by electricity and its production in a pure state or as an alloy with other metals. In a prior application for Letters Patent 6994, June 9, 1885, a process of smelting ores and reducing the salts of refractory metals by means of electricity is described, consisting in the use of pulverised carbon made incandescent by the passage of an electric current, and in carrying out the present invention the said process is preferably used. Ores of alumina are reduced in the said furnace by mixing them with granular carbon and passing an electric current through the mixture; but the product thereby obtained contains a considerable percentage of carbon which is taken up both chemically and mechanically by the aluminium. If, however, the ore of aluminium be reduced in company with tin, copper, manganese or other metal which will alloy with the aluminium, very little if any of the carbon is taken up. The alloying metal may be subsequently separated from the aluminium by amalgamation, lixiviation, or equivalent process, leaving the aluminium in the form of an amorphous powder. The method consists in mixing with the broken charcoal pieces of the metal which is to constitute the base of the alloy, whereby it is melted by the incandescent carbon and takes up the other metal, whatever it may be, that is being reduced.—J. T.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Process for Converting Petroleum and similar Hydrocarbons into Acids, Soaps, and Compounds analogous in constitution to Resins and Ethers. J. Imray. From Dr. Eugen Schaal, of Stuttgart. Eng. Pat. 12,806, September 25, 1884.

PETROLEUM and hydrocarbons resulting from the dry distillation of coal, shale, peat, etc., are heated with caustic alkalis, their carbonates, alkaline earths, or other substances having an alkaline reaction, with or without pressure, in a current of air or oxygen; the hydrocarbons are said to be converted into acids, and to form soaps. These are removed, and decomposed with mineral acid, the resulting acids being separated by distillation, fractional precipitation, or extraction with benzene or petroleum. Other oxidising agents are also employed, such as chloride of lime, at from 130° to 200° C., after which the lime is removed by hydrochloric acid, and the remaining oil compound (after separation of the acids) is treated with about 50% caustic soda at from 200° to 300° C. In some cases nitric acid is employed in the gaseous form together with a strong current of air, at about 100° C. Super-oxidation, which sometimes occurs with the liquid acids, apparently by formation of dry acids, can be brought back again by treatment with zinc powder. The separate fractions of the acid mixtures resulting from oxidation of the hydrocarbons may be used partly for the production of ether-like bodies, partly for soaps, and partly may be themselves used as such. The most volatile acids give, with methyl, ethyl, butyl, and amyl alcohols, useful aromatic ethers suitable for perfumes. The acids of higher constitution are very nearly related to oleic acid.—W. L. C.

Improvements in Apparatus for Solidifying Paraffin in Oils. F. N. Mackay and W. Baxter. Eng. Pat. 14,114, October 25, 1884.

THE oil is cooled in tanks surrounded with a refrigerating medium, and these tanks are provided with scrapers and agitators worked from an overhead shaft, and used in such a manner as will best ensure (1) the contents being mixed while cooling is being done, and (2) the cooling surfaces being continually freed from frozen paraffin. The whole mass is gradually brought down nearly to the temperature of the refrigerating medium, after which the discharge-ways are opened, and the contents of the tanks are allowed to flow to the press pumps. Drawings are given.—W. L. C.

Improvements in the Preparation of Oils used for Lubricating Wools preparatory to Spinning. C. Rumble and F. Sear. Eng. Pat. 15,031, November 14, 1884.

TO avoid the tendency to spontaneous heating in such oils, some metallic or ammonium salt or salts of fatty or resinous acids are dissolved therein, prior to their use. In practice about 10% of sodium oleate is dissolved in the oil at a temperature not exceeding 260° F.—W. L. C.

Improvements relating to the Purification of Fatty or Oleaginous Substances, and Apparatus therefor. W. R. Lake. From A. F. de Nugé, Paris. Eng. Pat. 15,531, November 25, 1884.

THIS patent contains the description, illustrated by drawings, of special mechanical arrangements for subjecting oils to the successive action (1) of caustic alkali, (2) of a current of steam, for purposes of purification. Three sets of vessels are described, in all of which the operations are continuous. In the first, the oil and alkali are mixed, and separated again; in the second, or "vaporising column," the oil is well steamed; in the third, the soap formed in the first operation is decomposed.—W. L. C.

Preparation and Application of Improved Hygienic and Disinfecting Substances, for use as Candles, Nightlights, Tapers, Lamp-oil, and such-like, or as External Remedies. E. B. Watson and H. B. Fulton. Eng. Pat. 9341, August 5, 1885.

For illuminating purposes, 1 oz. of sublimed iodine is dissolved in about 50lb. of solid paraffin (for candles) or in from 7 to 10 gallons of paraffin oil. For external remedies, in lieu of "tincture of iodine," the solution of iodine in petroleum spirit, etc., may be painted on the affected part, or solid paraffin impregnated with iodine may be used as a plaster.—W. L. C.

An Improved Process for Preserving Crude Animal Fats. P. A. Newton. Eng. Pat. 9380, August 6, 1885.

Crude fats are soaked for two days in a saturated solution of salicylic acid at 35° C., and are then packed in hermetically closed casks which are filled up with the solution.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in Vulcanised Kerite Compounds, and in Processes for the Manufacture of the same. H. J. Allison. From A. G. Day, of New York City. Eng. Pats. 8786 and 8787, July 21, 1885.

In 1878, A. G. Day patented indiarubber substitute, in the manufacture of which sulphur was heated with mixtures of oils and tar, and wax was used to moderate the intensity of the action of the sulphur. According to the present patents, one-half of this sulphur is to be replaced by an equivalent quantity of a metallic sulphide—as, *e.g.*, that of antimony. This not only performs the vulcanising function of the sulphur, but serves as "the heat controller," an office which, it is stated, it is impossible for sulphur used alone to fulfil. Small quantities of vegetable astringents are also incorporated with the mass, all operations being conducted between about 230° and 280° F.—W. L. C.

XIV.—AGRICULTURE, MANURES, Etc.

Hydration of Soils. H. Hellriegel. Rep. Anal. Chem. **5**, 242.

The author has investigated the rate of hydration of soils of average composition in an atmosphere saturated with aqueous vapour. The specimens were previously dried, and were exposed in the form of a column 70mm. in height by 50 in diameter, being contained in glass cylinders of corresponding dimensions. The absorption proceeds rapidly at first, one-half of the water taken up during 700 hours' exposure being absorbed during the first 100 hours. (Comp. *Chem. News*, 44, 101, 209.)

The author also investigated the downward passage and distribution of water through columns of soil, with the view of throwing light upon the appropriation of the rainfall. The phenomena observed are, in respect of the same soil, similar to those of the motions of liquids in capillary tubes, and vary in intensity in proportion to the fineness of division of the soil. In regard to the retention of water, variations are observed with variations in composition of the soil. At the conclusion of the experiments the quantity held *(a)* by garden mould was 20·5 per cent.; *(b)* by a sandy loam, 23·3 per cent.; and *(c)* by sand, 19·3 per cent. (Cf. *Centralb. f. Agrikulturchem.* 14, 840).—C. F. C.

On New Species of Potatoes. Christy. New Commercial Plants and Drugs, No. 8.

Besides our potato-bearing *Solanum tuberosum*, there are, amongst the 700 species of solanum, about five which also bear tubers—*S. Commersonii, maglia, immite, verrucosum, Jamesii,*—of these *S. Commersonii* has been cultivated in its native country perhaps for some time. Experiments have been made in England to introduce some of these species and to cross them with the ordinary potato, in order to obtain a product which might possibly not be susceptible to the potato disease. *Solanum maglia* grows in its native country, Chili, on the sea-shore, in loose sandy ground, and has externally much similarity with *S. tuberosum*. The plant appears to be especially suitable for England, and has been already cultivated in Chiswick in the first quarter of this century, where it produced abundantly, as many as thirty tubers on each plant, of quality equal to the ordinary potato. Recently sixty-one tubers were planted in two sections, in which those of a light colour were separated from those of a red colour. The tubers gathered were nearly all red. On the other hand, the tubers originally planted were only of the size of pigeons' eggs, but those obtained by cultivation were considerably larger. When cooked they proved of good quality. Crossing with the best sorts of ordinary potato gave some ripe berries with an abundant quantity of seeds. *S. Commersonii (S. Ohrondii)* occurs in Uruguay, Buenos Ayres, and Argentine, prefers stony ground, and likewise resembles the *S. tuberosum*. Cultivation experiments had little success, only a few tubers being obtained. A third sort, *S. Jamesii*, has external characteristics differing very perceptibly from the others; it grows about 10 inches high, and is distinguished by its very narrow leaves. It produced tubers abundantly, but these were considerably smaller than those originally planted. The tubers of the last two sorts were ripe earlier than those from *S. maglia*. —G. H. B.

Improvements in Deodorising Substances for Manures. W. H. Samson, Maidstone. Eng. Pat. 13,080, October 2, 1884.

Excrementary matter is caught in receivers containing any of the disinfectants now in common use. It is afterwards carried away in hermetically-scaled tanks and reduced by evaporation to a dry powder suitable for fertilising purposes.—C. C. H.

XV.—SUGAR, GUMS, STARCHES, Etc.

Apparatus for the Manufacture of Sugar. Dingl. Polyt. J. **256**, 503—506.

C. Scherer proposes to make cloth *filter-bags* withstand greater pressure by placing them within a net of wire gauze. An arrangement is also shown in which the filter is surrounded by a steam jacket.

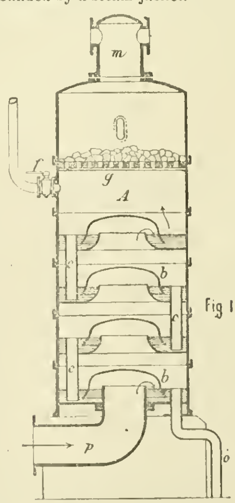


Fig 1

Apparatus for Washing Carbonic Anhydride.—The gas used in the Napajedl and Raigern sugar works is

obtained from limekilns. It enters the cast-iron cylinder A (Fig. 1) through the pipe *p*, and is constrained to pass through the water in the successive trays by means of the caps *b*. A layer of limestone on the grid *g* frees the gas from the water carried up mechanically, and also from sulphurous anhydride. The washed gas passes away through *m*; the wash-water is admitted at *f*, and flows away at *o*.

The syrup enters at *c* and leaves the tank at *d*, and passes into the test tank B, from whence it goes to the boiler. In each compartment is an agitator, *g*. Usually the gas is introduced by the perforated tubes *b* into the two chambers I. and II. only, and from these it passes to the other chambers by means of the perforations *i* in the partitions, passing away finally through *k*. Or the gas from *k* may be passed into the apparatus (Fig. 4) at *m*, through which the syrup and milk-of-lime is passed from *l* to *o*, and thence into the main tank at *c*. The gas can also be passed into the main tank at *g*, if necessary, as well as, or instead of, at *b*

Fig 2. Fig 3

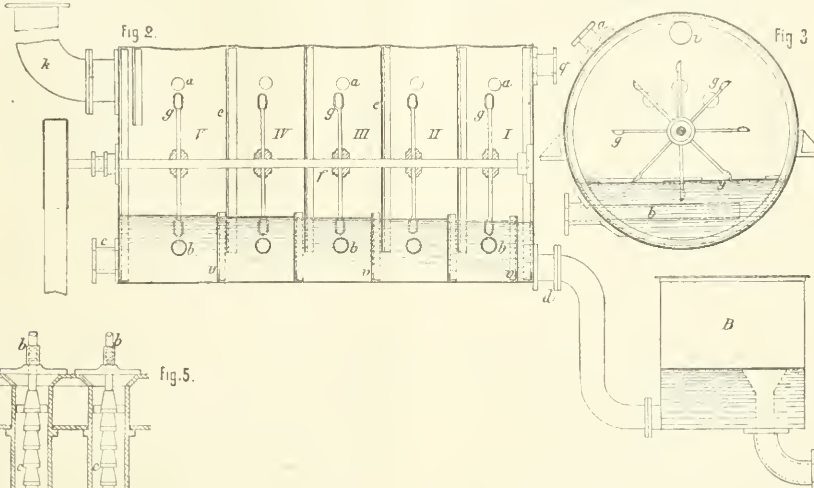


Fig.5.

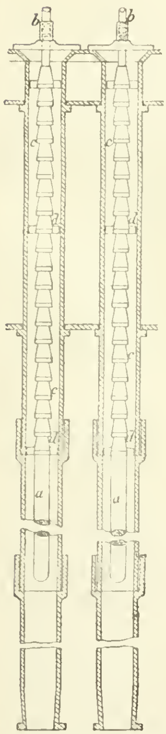


Fig 4.

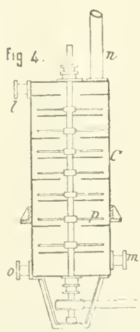


Fig 7

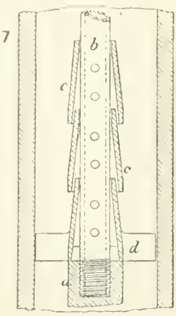
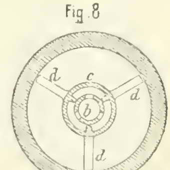


Fig 6.

Fig 8

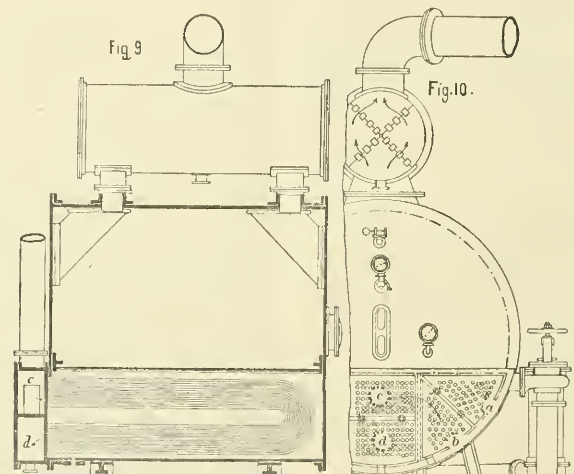


Saturating Tank for Carbonic Anhydride.—Forstrenter Bros. (Ger. Pat. 29,039, March 11, 1884) construct the apparatus as shown in Figs. 2, 3 and 4. The tank is divided into compartments by the partitions *e e* and *v v*.

Gas-extraction Tube for Bone-black Retort. — A. Schneider (Ger. Pat. 29,048, April 13, 1884), describes a massive cast-iron hanging retort (Figs. 5, 6, 7 and 8), down the centre of which passes a perforated gas-tube *b*, which is surrounded by small conical sleeves, *c*. Each sleeve has three ribs inside to keep it in position and to maintain a passage for the gases from the bone-black to the tube.

Steam-worm for Vacuum-pan.—F. Hallström (Ger. Pat. 29,538, April 30, 1884) proposes to gradually reduce the diameter of the worm from 150mm. where the steam enters to 50mm. where the steam leaves, in order to increase the efficiency of apparatus.

Horizontal Steam Apparatus.—F. Weigl describes an arrangement of horseshoe-shaped steam tubes which can be easily kept steam-tight. Figs. 9 and 10 show that the heating space is divided into three main compartments by means of two fixed partitions. Each compartment is divided into two smaller ones by movable partitions



screwed on to the tube-plate, one of the smaller chambers being the steam-entrance side and the other being the steam-exit side. The steam passes through two similar large valves on both sides of the apparatus simultaneously to the two outer chambers *a*, returning through the neighbouring chamber *b*; thence it passes from both sides into *c*, and through the middle system of tubes to *d*.

Vacuum-pan Exhauster.—P. Hambruch (Ger. Pat. 30,491, June 22, 1844) proposes to employ an ejection apparatus worked by a liquid which readily absorbs water, the liquid to be passed back to a reservoir tank by means of a pump.—J. T.

The Treatment of Bone-black. P. Degener and J. Lach. Dingl. Polyt. J. **256**, 519; and Ger. Pat. 31,358, June 6, 1884.

Freshly-ignited bone-black moistened with as much water as it can take up, and exposed to light and air, produces, even in two or three minutes, a perceptible quantity of hydrogen peroxide. Bone-black thus treated is much more active than the unmoistened material. The purification of exhausted bone-black can be conducted completely, or partially and completed in the ordinary way, when the process is much facilitated by the hydrogen peroxide produced. In practice forty-eight hours give good results when the layers are 3 inches thick and are frequently sprinkled and turned over. If milk-of-lime be sprinkled over the bone-black, peroxide of the alkaline earth is produced; the same thing holds good for other earths and the alkalis.—J. T.

On the Non-crystallisable Products of the Action of Diastase upon Starch. H. T. Brown and G. H. Morris. J. Chem. Soc. 1885, 527.

The authors give a historical *resumé* of the above subject, and add that the present paper must be looked upon as a continuation of a previous paper by one of them (Brown and Heron, *J. Chem. Soc.* 1879, 596). The previous paper confirmed O'Sullivan's statement, that the properties of the products of the transformation of starch by diastase can be accounted for by the presence only of maltose and a non-reducing dextrin with a rotary power of $[\alpha]\ j_{3.86} = 216°$.

The authors found, contrary to O'Sullivan, that the dextrins separated by alcohol from any starch transformation are susceptible to the action of diastase to the same extent as before separation. By fractionating a dextrin by repeated partial precipitation with alcohol, and then hydrolysing by malt extract or diastase the separate fractions, and ascertaining the amount of maltose produced from each, it is possible to determine whether a particular dextrin is a single substance or a mixture of dextrins. The authors found, for instance, that the dextrin in their No. 8 equation is a mixture.

The authors found it impossible to prepare a non-reducing dextrin either by fermentation or by precipitation with alcohol. Bondonneau's method (*Bull Soc. Chim.* 21, 50 and 149), by boiling with cupric chloride and sufficient caustic soda to redissolve the precipitate first formed, and then filtration, acidification, and precipitation by alcohol, was not found satisfactory by the authors. They were, however, very successful with an application of Wiley's modification of Knapp's alkaline mercuric cyanide solution process (*Chem. News*, 46, 175), which had the great advantage, in addition to the pro-

duction of dextrins free from reducing power, of not hydrolysing the dextrin during the process.

The authors have found that a new body, to which they give the name of malto-dextrin, is produced by the limited action of malt extract upon starch. Herzfeld described, in 1879, a new product, which the authors consider must have been malto-dextrin in an impure condition. The authors' malto-dextrin is non-fermentable by *saccharomyces cerevisiæ* of the high fermentation; by diastase it is converted completely into maltose; alcohol only acts upon it as a whole, and does not precipitate dextrin from it. A mixture of maltose and dextrin having the same optical and reducing properties, is readily separated by alcohol into maltose and dextrin; diastase always leaves some dextrin unacted on, and the maltose readily ferments. The authors consider the composition of malto-dextrin to be $\left\{ \begin{matrix} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_2. \end{matrix} \right.$ Although malto-dextrin is unfermentable by the "top yeast," yet "bottom yeast"—*e.g.*, *saccharomyces ellipticus* and *S. pastorianus*—has, under certain conditions, the power of hydrolysing and then fermenting.

A further proof of the homogeneity of malto-dextrin is supplied by dialysis, a mixture of maltose and dextrin, having the same optical and reducing properties being split up into dextrin and maltose by dialysis, whilst malto-dextrin dialyses as a whole.—F. L. T.

Improvements in the Manufacture of Sugar and in Apparatus therefor. A. Fesca, Berlin. Eng. Pat. 12,469, September 16, 1884.

The author states that in the manufacture of cube sugar, either in the form of prisms or plates, a uniform product is not obtained, because the liquor used in the process of liquoring in the centrifugal does not evenly penetrate the mass, owing to the obstructions offered by the partitions of the mould. This he proposes to overcome by constructing the moulds, formed of plates, as at present, with tongues or projections, so that when the whole are bolted together, an upper chamber is formed above the mould. After the sugar has been run into the moulds and centrifugated, the upper part is filled with "thick liquor" or "liquor paste," made from sugar dust. When this has set, by the withdrawal of liquor from it by absorption, the moulds are again placed in the centrifugal, and liquored in the usual way. The mass of sugar in the upper part of the moulds over the moulded portions, serves as an intermediary, and evenly distributes the liquor through the plates or prisms beneath, and this results in the formation of a more uniform product. The claims are (1) the process of "preliminary liquoring while at rest;" (2) the form of mould which enables this to be accomplished; (3) the constructions of the moulds for prisms; (4) the construction of the moulds for plates. —C. C. H.

Improvements in the Manufacture of Grape-Sugar or Glucose. W. R. Lake. From W. T. Jebb, Buffalo, U.S.A. Eng. Pat. 6140, May 19, 1885.

In manufacturing glucose from Indian corn, it has been the practice to eliminate the hulls, gluten and germs from the starch by grinding the corn with water, then separating the coarse offal from the starch by sifting upon sieves, which are supplied with sprays of water, whereby the starch is washed through the meshes of the sieve, while the offal passes off over the tail; then separating the gluten and oil from the starch by treatment with caustic alkali, and repeatedly depositing and washing the starch, and then converting the refined starch so obtained. This process requires large quantities of water, and capacious receptacles for settling the starch, and is comparatively costly, while it leaves the offal in a wet, undesirable condition. It has also been attempted to manufacture glucose by grinding the corn and directly converting all the constituent parts of the grain; but this method has not been successful, as it gives impure and discoloured products. The object of this invention is to produce glucose from Indian corn, by removing the hulls, gluten and germs from the crude starch, without going to the extent of manufacturing refined starch, and consists in steeping the corn, then detaching the hulls and germs from the starchy portions of the kernels by whipping or beating without additional water, then separating the hulls and germs from the crude starch by sifting, and then acidulating the crude starch, and converting it into glucose under pressure.—A. W.

Improvements in the Manufacture of Hard Sugar. W. R. Lake. From F. O. Matthiessen, U.S.A. Eng. Pat. 9326, August 4, 1885.

This is a process for transforming soft sugar into hard sugar without increasing its density, the product being a comparatively light hard sugar, having but two smooth sides, the remaining four sides having the rough appearance produced by cleavage. A layer of soft sugar, or a mixture of granulated and soft sugar, spread upon the bottom of a horizontal pan, to the depth of, say $1\frac{1}{16}$ of an inch, is subjected to pressure so as to reduce the thickness of the layer by from $\frac{1}{32}$ to $\frac{1}{16}$ of an inch. The extent of pressure required at this stage of the operation will vary, according to the percentage of moisture in the sugar. The more moist the sugar the less will be the pressure required. The compressed sugar is then subjected to a moderate heat for, say, six hours, whereby it is transformed into a cake of hard sugar, which is divided into cubes or blocks, by cleaving it in parallel lines both lengthwise and crosswise.—A. W.

XVI.—BREWING, WINES, SPIRITS, Etc.

Recent Work in Brewing. Dingl. Polyt. J. **256**, 456.

The following abstracts are from papers which appear in the Proceedings of the third general meeting of the Berlin Union for Brewing Research and Teaching:—

The Influence of Hops upon the Keeping Properties of Beer. M. Hayduck.

Hops exert a two-fold influence upon the durability of beer. They check the growth of disease ferments, and also precipitate the greater part of the albuminous matter of the wort by means of the tannin which they contain. Hops also somewhat improve the yeast fermentation. The author has made experiments upon the retarding influence of hops, bacterial growth, especially the lactic acid ferment. He finds that malt mashed at 62°, and fermented at about 50°, gives a pure lactic acid fermentation, no volatile acid being formed. When, however, he ferments with addition of an aqueous extract of hops, the growth of bacteria is stopped, and a pure alcoholic fermentation takes place. The same antiseptic effect is produced by the extract from 2grms. hops per litre of wort, as by the extract from 30grms. per litre, and even ½grm. per litre produces a marked effect. The author endeavoured to isolate the antiseptic substance, and concludes that the action is due to the bitter hop-resin, hop-oil and hop-tannin being without action. He finds that there is a marked difference in the antiseptic action of different kinds of hops, and that the efficacy decreased with age. Hops which had been once extracted, gave, on second and third treatments, liquids as strong in antiseptic power as the first extract. Addition of hops does not prevent acetic fermentation; in fact, the fermentation appeared to be more active in the presence of hops. Butyric acid fermentation appeared to be stopped by addition of hops; but the author is still working at the subject, and promises early results.

Deinhardt, continuing his researches on "hopping," finds that beer from a high-dried malt, requires a much larger quantity of hops to produce the same effect, than beer from a low-dried malt. Also, that beer hopped to a strongly bitter flavour loses a large portion of the hop-bitter on keeping. He also determines the smallest and largest quantity of hops necessary to produce a given effect, and the influence of time of boiling with hops upon the flavour of beer.

Matz gave the results which he had obtained with two samples of pure yeast from the Carlsberg laboratory. The beer from sample No. 1 brightened very slowly, and required to be stored for some time; but it possessed great keeping properties. No. 2 brightened very quickly, but the beer would not stand long transport.

Francke discussed the question whether the breaking of beer was dependent upon the condition of the barley. He ascribes a bad breaking to a deficient supply of yeast food, and concludes that it is necessary for the malt to be stored for six or eight weeks before it is used, since an undoubted molecular change goes on slowly in the stored grain. He also remarks that last year's malt was deficient in diastatic power.

Reinicke has experimented upon washing steeped and dry barley. He recommends that barley should be washed after steeping, to remove injurious matter, and also to remove the smell of the steeping water. He states that the difference in washed and unwashed barley can be detected by the smell of the grain on the floors during the malting process. Experiments showed that washing dry barley was ineffectual for removing the dirt particles.

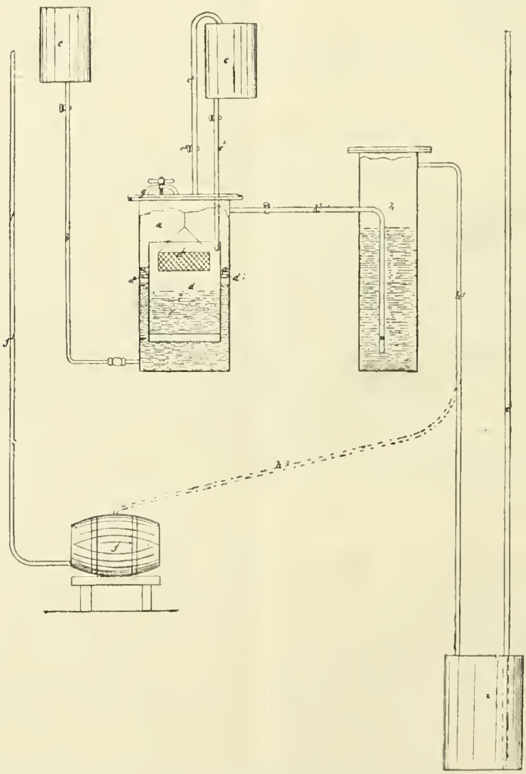
Delbrück ascribes the reddening of white beer to a round bacterium, resembling sarcina. He thinks it possible to find hops which will exert an antiseptic action upon this ferment.

Delbrück concludes that the grounds for judging a water for brewing purposes are still uncertain. An apparently bad water may yield a good sound beer; and the only sure guide is to make a brewing with the water in question.

Noback states that the "steep" water determines the character of the beer, that it is impossible to brew a Pilsen beer with Munich water, and *vice versâ*—the inorganic constituents of the water determining the character of the beer, and that the three types of beer—Pilsen, Vienna, and Munich—can only be obtained with the respective waters. On the other hand, Gregory maintains that the different types may be obtained with the same water.—G. H. M.

Improvements in Apparatus for Producing Carbonic Acid Gas and for Utilising the same in Raising Malt Liquors, and for other Analogous Purposes. C. R. Bonne, Manchester. Eng. Pat. 6821, June 4, 1885.

THE apparatus described is self-regulating in pressure and quantity of the gas produced, and hence specially suitable for raising malt liquors. An enclosed vessel a is supplied with water from the cistern c overhead. Floating upon the water in a is an open-topped float d, made of any acid-resisting material, the buoyancy of which is increased by forming the bottom hollow. The float receives a supply of acid from the acid cistern e, the pressure being ensured by the upper part of the cistern being connected with the generator a.



Suspended from the top of a is a perforated cage j containing the carbonate required. Upon starting the apparatus, water is admitted into the generator from the cistern c. This causes the float to rise until the flange d' comes into contact with a corresponding flange a', thus closing the communication between the upper and lower part of a. Simultaneously the acid comes in contact with the carbonate, liberating carbonic dioxide, which accumulates in a, and forces the water back into the cistern c. By this means the float d is lowered at

the same time, and the acid not being in contact with the carbonate, the supply of gas is stopped until by reason of the gas being consumed the pressure is once more reduced; the water level is raised again, and the same operation is repeated. In order to raise a malt liquor by this machine, the latter is connected with the tank, cask, etc., by a pipe, so that the gas, after being washed in *h*, can exercise a pressure on the surface, and so cause the liquor to rise to the desired level. The degree of pressure depends upon the head of water in the cistern *c*. If it be required to work at a higher pressure, the pipe *b* is divided into two branches, one fitted with a back pressure valve to permit the water to flow from the cistern *c* only, but not to return thither, and the other branch provided with a weighted valve, which only opens when a certain pressure is reached.—S. H.

Acidity of Beer. A. Bertschinger. Dingl. Polyt. J. **256**, 519.

ACIDITY of beer is best estimated by adding 10cc. free from carbonic acid, to a decinormal solution of soda, and, after the addition of litmus, titrating by means of decinormal sulphuric acid. Swiss beer contains from 0·12 to 0·22 per cent. free acid, reckoned as lactic acid. —J. T.

Vent Peg adapted for Purifying the Air admitted to Fermentable Liquids. William Henry Hall. Eng. Pat. 13,201, October 4, 1884.

THIS is an arrangement by which the air admitted through the vent to a cask or other closed vessel containing beer, etc., is made to pass through some filtering material, such as water, solution of salicylic acid or flannel, in order to remove from it impurities likely to decompose the beer.—G. H. M.

Improvements in or relating to the Treatment of Maize in the Manufacture of Spirits. William R. Lake. From William Thomas Jebb, New York. Eng. Pat. 4957, April 21, 1885.

THIS patent refers to the separation from maize of a starch meal free from the hulls and germs of the corns. The separation is effected by steeping the corn in warm water (about 140°) for some hours, until the kernels become swelled; the water is then drained off, and the steeped maize introduced into a machine in which it is thoroughly beaten or whipped. This reduces the starchy matter to powder, without breaking up the hulls and germs. In this way the corns are divided into three distinct products—the finely-granulated starchy portions, the germs which are considerably larger than the granules, and the still larger hulls. The three bodies are then separated by sifting, and the pure starchy bodies may be mashed and fermented. The author claims that the liberation of fusel oil, etc., is avoided by getting rid of the germs and hulls; that the conversion of the starch is effected more uniformly; that the fermentation is more under control; that the distillation of the spirit can be carried on at a lower temperature and with less loss of spirit; and that a better quality of spirits is produced. The hulls and germs may be used for fodder, or may be used for the preparation of oil-cakes. Drawings of the plant required are given, including a tank for developing the starch under pressure.—G. H. M.

Improvements in the Manufacture of Beer. Philip M. Justice. From Andrew W. Billings, New York. Eng. Pat. 9847, August 19, 1885.

A CERTAIN percentage of raw grain is to be added, in the manufacture of beer or ale, whereby the quantity of malt required is reduced, a superior beer produced, and a great saving in labour and expense effected. These results are obtained by making two mashes, one of malt in the ordinary manner, and the other a supplementary mash of Indian corn, rice, or other raw grain. The grain for the latter mash is ground, mixed with the requisite quantity of water at 112° F. in a special form of mashing apparatus, and the mixture then heated to about 210° F. by the injection of live steam. The pasty mash so obtained is then quickly cooled to 140° by the injection of cold water, and sufficient ground malt is added to saccharify the starch. At the end of about two hours live steam is again injected, and the temperature raised to about 185°; the mash is then allowed to cool and run into the mash prepared from malt in the usual way. The subsequent operations are carried on as in an ordinary brewing. The author claims for his method complete conversion, largest yield of extract, and no extraction of oils, avoiding thereby any corn-like flavour or smell. The details of the process may be varied in several respects. A full illustrated description of the apparatus used is given.

—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Improved Process of Preserving Smoked Fish. O. Syllwasschy, Ellerbeck. Eng. Pat. 12,929, September 29, 1884.

THE fish are first smoked and then pickled, after which they are packed in barrels. Prior to use, and after removal from the barrels, they are washed to remove the salt, and again smoked. It is claimed that after treatment by this method the fish can be kept longer and without injuring the flavour, even of the most delicate varieties.—C. C. H.

Improvements in the Preparation of Caseine, etc. A. M. Clark, London. From E. E. Childs, Brooklyn. Eng. Pat. 14,240, October 28, 1884.

UNSUITED for abstracting.—C. C. H.

Process of Treating Fish Roe, etc. E. E. Waters, New York. Eng. Pat. 7016, June 9, 1885.

THE roes are first washed to remove the blood, salt, etc.; they are then split and macerated for twenty-four hours in an aqueous solution of ammonia containing from two to five per cent. of concentrated ammonia. After straining, the solution is either evaporated or the albumen precipitated by the addition of an acid, pressed and dried. In the latter case it is desirable to moisten the cake in a solution of ammonia before drying to gelatinise the exterior. Caustic potash or soda may be used in place of ammonia.—C. C. H.

(*B*) SANITARY CHEMISTRY.

Report on the Waters of the Hudson River. C. F. Chandler, Ph.D.

THIS investigation was undertaken by the author at the request of the Water Commissioners of the City of Albany. Its object was to determine whether the water of the Hudson River, the source of the supply of the city, was in any way rendered unfit for consumption by the reception of the sewage discharge of the cities situated above the intake, notably Troy, with a population of 60,000. Analysis by Wanklyn's method failed to show any considerable quantity of nitrogenous matter indicative of sewage pollution; indeed, the water supplied to Albany contained less albumenoid ammonia, after it had received the sewage of Troy, than the water from the river above Troy at a place where it is practically free from any considerable pollution. Biological examination the author considers in this case to yield a negative result, because fermentation experiments did not appear to develop any organisms which were not developed by water absolutely free from sewage pollution. With respect to the transmission of disease by a water which although polluted has by oxidation undergone purification, after reviewing the opinions of Huxley, Tidy, Letheby, Angus

Smith, Magnen, and others, he concludes that it does not appear to rest on any substantial basis that diseases have ever been transmitted by a water which would not have been condemned by the ordinary methods of analysis. Koch's theory he views in a similar light, and does not consider it fairly established. In conclusion, notwithstanding the pollution of the Hudson by the sewage discharge of the city of Troy, Professor Chandler maintains that dilution combined with oxidation effectually removes all evils which might accrue from the pollution. After comparison with the water supply of European cities, and a comparison of the death-rate of the leading American cities, he sees no reason why the source of supply should not be considered a good one, and views the objections raised as more sentimental than sound.—C. C. H.

Tarred Water Pipes. W. Thörner. Chem. Zeit. 1885, 926.

TARRED water pipes frequently contaminate the water if the tarring is not properly done. It is best, where practicable, to dip the pipes, when sufficiently cool after casting, in a liquid which wets them easily (alcohol, petroleum, crude benzene, toluene, etc.). The liquid thus used must mix readily with tar and easily evaporate. After moistening, the pipe is tarred by immersion. —J. T.

Improvements in the Preparation of Agents to be used in the Treatment of Sewage, etc., and in the Treatment of such Matters. J. W. Slater, London. Eng. Pat. 12,830, September 26, 1884.

(1.) PEAT is mixed with water and ground to a thin mixture. (2.) Iron slags or slag wool are treated with hydrochloric acid, sufficient to convert the whole of the alumina into chloride, and leave a slight excess of acid. The sewage is treated by adding from twenty to thirty parts of mixture (1) to 10,000 parts of sewage, and subsequently with six to eight parts of mixture (2). The organic matters in solution and suspension are precipitated and allowed to subside. The quantity of clay used in (1) depends on the temperature of the sewage—ordinarily from twenty-five to thirty per cent. of the weight of the solid matter in the peat, and the lower the temperature the less the quantity required. The slag should be free from oxides of iron, lime, magnesia, and alkalis. Chloride of copper may be used to oxidise the iron salts present. If more than thirty grains of organic matter per gallon of sewage is present, larger proportions than above specified are used. The claims are: (1.) The treatment of sewage by the mixture of peat and clay; (2.) The treatment by the subsequent addition of the solution of the slags in hydrochloric acid.—C. C. H.

Improvements in Filters; a Device for Cleansing the Filtering Bodies of the same. C. E. Chamberland, Paris. Eng. Pat. 6646, June 2, 1885.

THE author in a previous patent described the construction of a filter which removes the suspended matter from water and also the microbes and germs. This consists of a cylinder of fine porcelain through which the water is forced from the exterior to the interior. In operating upon a large quantity several of these are placed in a closed vessel; for removing the deposited matters from the surface of the cylinders the device described in this specification is intended. Two plates which have holes encircling the filtering cylinders are bolted together and nip between them canvas, rubber, or asbestos, so as to fit tightly against the exterior of the porcelain cylinders. A central screw forces the plates from end to end of the containing vessel, and thus scrubs off the solid matter from the cylinders. Steam may also be used for regenerating the porcelain.—C. C. H.

Improved Process for the Economical Production of a Porous Carbon, etc. G. E. Ellis, Newton Abbot. Eng. Pat. 7318, June 16, 1885.

THE material used is the carbonaceous clay deposit found above the Devonshire lignite beds; the open face deposits are preferred. After a preliminary drying the clay is pulverised and incorporated with ten to fifteen per cent. of lignite, fifteen to twenty-five per cent. of aluminious schist, one to two per cent. of coal-tar or pitch, and is then formed into blocks in a brick press. After drying, the bricks are heated in retorts and finally granulated.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Secondary Batteries. Alexander Henry Reed, Middlesex. Eng. Pat. 14,508, November 3, 1884.

BY this invention a secondary battery is constructed, instead of with lead, with zinc in an alkaline solution, and not, as is usual, in an acid solution. Consequently the oxide of zinc on dissolution in the potash or soda, or any other metallic oxide soluble in alkalis, is employed in the construction of the pile, the positive pole of which is constituted by hydrates of oxides or anhydrous oxides insoluble in potash or soda as depolarisers.—T.

Improvements in the Manufacture of Carbons for Incandescent Electric Lamps. Mortimer Evans and Frank Wynne, Lambeth, London. Eng. Pat. 12,675, September 22, 1884.

THIS invention has regard to material from which carbon filaments may be produced, and to the treatment of this, and consists in first obtaining a substance of a homogeneous nature, composed of a substance which may be carbonised, and treating it in such a way as to form filaments or threads of uniform sectional area and quality.—T.

Improvements in the Construction and Application of Carbon or Carbonaceous Electrodes for Primary and Secondary Elements. Richard Heber Radford, Sheffield, Yorkshire. From Hermann Friedrich Bouté Schaefer, Berlin.

IN order to form electrodes of carbon, or carbonaceous material in large sizes, a hose (*i.e.*, a flexible tubular case or envelope) is filled, during its production by the machine, with small particles of carbon or carbonaceous material, and pressed in firmly, and in such a manner that the production of the hose progresses in the same ratio as it is filled.—T.

XIX.—PAPER, PASTEBOARD, Etc.

An Improved Cold Process for the Manufacture of Paper Pulps and Bleached or Unbleached Textile Fibres, and Apparatus therefor. Hippolyte Vessier and Amédée Wilbaux. Eng. Pat. 14,859, Nov. 11, 1884.

THE process consists in treating the material, such as straw, esparto, flax, cotton, old papers, wood, rags, etc., with a cold solution of caustic soda, varying in strength from 10° to 25° B. After steeping in this bath for one to eight hours, according to the nature of the material, it is washed in a special apparatus, a drawing of which is given, and bleached with a solution of bleaching powder and salt, in the proportion of one part of the former to seven parts of the latter.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Work of the Pharmaceutical Commission. Arch. Pharm. (1885), **23**, 466, 497.

THE work of the commission begins with the publication of elaborated articles on the Pharmacopœia, and from it statements of general interest are selected.

Vinegar. Concerning the colour an alteration is made therein, that the vinegar must be colourless or feebly yellow, whilst the Pharmacopœia allows a yellow colour. The residue on evaporation must not exceed 0·5%, against the former exceedingly high 1·5%.

Borax.—The former statement of the special reaction, "The aqueous solution turns turmeric paper brown on the addition of hydrochloric acid," is amended by the following: "The aqueous solution reacts alkaline; it turns turmeric paper brownish-red after some time, even after acidification by hydrochloric acid."

Bromine.—The statement concerning the solubility in water is affirmed in that it dissolves in 30 parts of water at 15°. The estimation of the solubility in sodium hydrate is extended in that this solution must separate no oily droplets, nor give out a smell like chloroform, which would indicate the presence of bromoform. A rough test for the amount of chlorine is given, which allows about 3% to pass. 1cc. of the bromine solution (1 in 30) is diluted with 9cc. water, and a small excess of ammonium carbonate and silver nitrate is added and well-shaken up. After filtration the filtrate, on the addition of nitric acid, must not show more than an opalescence.

Extracts.—In testing for copper, the acidified solution is to be heated to boiling, and then cooled before testing with an iron rod.

Soda-ley.—Traces of alumina are allowed. Diluted with 15 parts of water and acidified with acetic acid, the addition of barium nitrate or of silver nitrate and nitric acid must not produce more than opalescence. This test excludes 0·15% chlorine and 0·3% sulphuric acid.

Opium.—The following directions are given for testing this much-discussed subject of research, and the minimum quantity of morphia is put at 10%: 8grms. powdered opium are placed on a filter of 80mm. diameter, and are gradually washed with 18grms. of ether, the funnel being kept covered. The opium is then dried in a water bath and shaken in a flask with 80grms. water at 15°. After standing half-a-day, 42·5grms. of this aqueous opium extract are filtered off into a flask, 12grms. alcohol, 10grms. ether and 1grm. ammonia being added, and the mixture is kept in a closed vessel with frequent shaking for 12 hours at a temperature of 10° to 15°. A weighed filter of 80mm. diameter is then moistened with ether, and the ethereal layer from the flask is poured on it, and afterwards the whole contents of the flask, after shaking with 10grms. more of ether, are placed on the filter. The morphia crystals are then washed with a mixture of 2grms. dilute alcohol and 2grms. ether, and are weighed after a final drying at 100°. The weight must not be less than 0·4grm.

Tinctures.—The preparation is to consist of maceration for eight days in a well-closed flask in a shady place. Recourse to digestion is abandoned, because the much simpler maceration gives much more durable and quite as strong a tincture.

Wood Vinegar.—Testing for hydrochloric acid is added.

Chloride of Lime.—This must contain at least 20% of available chlorine.

Water-Glass.—The testing is extended to the estimation of caustic or carbonated alkali, because the presence of these renders it unsuitable for bandages. The following test is given: If equal parts of water-glass and spirits of wine are triturated together in a basin, a granular salt (tri- or tetrasilicate) must separate, and not a pappy (monosilicate) or greasy salt (bisilicate), and the filtered solution must not turn turmeric paper brown.

Liquid Paraffin.—A paraffin of at least ·880 sp. gr. is required, whilst the present pharmacopœia only specifies ·840 sp. gr. It must not boil below 360°. As a test of purity for the liquid, as well as for the solid paraffin, the following is given: 3grms. paraffin heated with 3cc. H_2SO_4 in the water bath, with frequent stirring for 15 minutes, must not produce a change in the paraffin, and the sulphuric acid must only be slightly coloured brown.
—G. H. B.

Cod-liver Oil and Iron. Pharm. Zeit. **30**, 507.

For the preparation of this drug, ferric benzoate is the most suitable. 60grms. toluenebenzoic acid dissolved in 300cc. boiling water are treated with 102 grms. ammonia solution (10%). To this solution is added a mixture of 100grms. ferric chloride solution (10% Fe.) and 300cc. water, and the precipitate is washed on a filter until free from chlorine; it is then pressed and dried. 20grms. of this ferric benzoate, together with 5grms. toluolbenzoic acid, are rubbed together with some cod-liver oil and then digested with 1kilo. cod-liver oil on the water-bath, with stirring for one hour. The cod-liver oil and iron thus prepared is filtered whilst warm; it contains 2% ferric benzoate, or 0·3% Fe., has a good taste, and owing to the free benzoic acid it keeps well.—G. H. B.

Compounds of the Alkaloids with Iodine Chloride. M. Dittmar. Ber. **18**, 1612.

A GENERAL reaction for pyridine and quinoline, and their alkaloid and other derivatives, consists in their combination with chloride of iodine to form very characteristic addition products containing one ClI for each pyridine-ring.

Thus, if X be an alkaloid containing one pyridine-nucleus, it will form a compound of the formula XICl, and if Y contain two pyridine-rings it will form a compound YI_2Cl_2.

These bodies are, for the most part, sparingly soluble yellow precipitates, which are produced by adding to a solution of the alkaloid a solution of iodine chloride in HCl, or a mixture of KI, KNO_2 and HCl (the latter solution is not always suitable). With an excess of chlorine they can form unstable compounds of the formula $XICl_3$ corresponding to iodine trichloride. They are readily attacked by NaOH and by NH_3, and with the latter they form compounds of the constitution $XINH_2$; these are dull-green or dull-red unstable bodies, insoluble in water, converted back into the chloriodides by HCl, and decomposed on boiling with alcohol according to the equation—

$$6XINH_2 = 3X + 3XNI_2 + 4NH_3 + N_2,$$

thus evolving one-third of their nitrogen.

These iodoammonia compounds are also produced by the combination of the alkaloid with iodide of nitrogen (NH_2I). The author is inclined to consider that the latter bodies are molecular compounds of the base with iodide of nitrogen, and that the chloriodides are molecular compounds of the base with ICl.

The hydroxyquinolines in which the OH group occurs in the benzene-ring, and tetrahydroquinoline and its derivatives do not combine directly with chloride of iodine, and are thus exceptions to the general rule.

The following are the reactions of some of the alkaloids and derivatives of quinoline towards this reagent:—

Theobromine and *Caffeïne*—No effect, since they are not derivatives of pyridine or quinoline.

Morphine—Separates iodine.

Quinoïdine—Light-brown amorphous ppt.

Quinine—Light-brown crystalline ppt.—

$$(C_{20}H_{24}N_2O_2I_2Cl_2)$$

Quinidine.—Light-yellow ppt. scarcely soluble in HCl.

Cinchonine—Light-yellow ppt.

Brucine—Light flocculent ppt.

Strychnine—Yellow ppt., soluble in HCl.

Papaverine—Yellow flocculent ppt., slightly soluble in HCl.

Codeine—Ppt. soluble in HCl.

Thebaine—Whitish ppt.

Narceine—Greenish-yellow ppt., soluble on heating, and reprecipitated as light-yellow needles.

Piperine, piperidine, aconitine, veratrine, narcotine, thebaine, codeine, and coneine—Yellow ppts.

Cocaine—Light-brown crystalline ppt.

Nicotine and *Atropine*—Yellow ppts. which dissolve on heating and reprecipitate as compact brown crystals.

Pyrrol—Black insoluble body (C_4H_5NICl).

p-Toluquinoline—Easily soluble reddish-yellow needles, $C_{10}H_9NICl,HCl$; melting point 112°, blackened by NH_3.

β-Naphthoquinoline—Light-yellow needles—

$$C_{13}H_9NICl,HCl;$$

melting point 148°, soluble in HCl, blackened by NH_3

Antipyrine—Light-yellow needles, $C_{11}H_{11}ION_2ICl$; melting point 142°, soluble in alcohol, blackened by NH_3.

Hydroxymethylquinoline—Yellow needles, soluble in alcohol, blackened by NH_3.

Quinaldine—Yellow needles, melting point 151°.

Diquinoline—Light-yellow ppt.—

$$C_{18}H_{12}N_2I_2Cl_2,H_2Cl_2:$$

insoluble in alcohol.—A. G. G.

Reaction between Brucine and Strychnine. A. Hanssen. Ber. **18**, 1917.

THE author has submitted brucine and strychnine to a similar process of oxidation with chromic and sulphuric acids. The resulting product is the same in both cases, and has the formula $C_{16}H_{18}N_2O_4$. It appears, therefore, that in the case of strychnine, the group C_5H_4, in that of brucine the group $C_7H_8O_2$, have been eliminated. The author explains this by supposing that the group C_5H_4 represents a benzene ring, joined to the group $C_{16}H_{18}N_2O_4$, as in "diphenyl." The explanation is borne out by the fact that strychnine forms nitro- and bromo-substitution products, which is not the case with the oxidation product. In the same manner the group $C_7H_8O_2$, split off by oxidation from brucine, is supposed to be a dimethoxy-benzene group, and brucine a dimethoxy-strychnine.—J. B. C.

Action of Caustic Alkalis on Cinchonine and other Cinchona Alkaloids. A. Krakau. Ber. **18**, 1934.

THE action of caustic alkalis was effected at a temperature of about 200°, in a current of superheated steam. By modifying the usual method in this way, the author obtained quinoline, lepidine, a solid substance remaining in the residue, and a thick oil which distilled with the other bases. The separation of the quinoline bases from this product was effected by steam. From cinchonidine, quinine and quinidine, similar products were obtained by the same method.—J. B. C.

Aseptol (Orthophenylsulphonic Acid). E. Serrant. Compt. Rend. **100**, 1465.

THIS compound is said to possess greater antiseptic properties than phenol, and its action is less injurious than that of phenol.—D. B.

Kolbe's Synthesis of Salicylic Acid. R. Schmitt. J. Prakt. Chem. 31, 397.

FROM the transformation of potassium phenylsulphate into potassium paraphenylsulphate, Baumann (*Ber.* 11, 1910) supposed that in the preparation of salicylic acid sodium phenylcarboxylate was at first formed, and was subsequently converted into sodium salicylate. This hypothesis is confirmed by Hentschel (*Ber.* 16, 795), who showed that in the presence of another molecule of sodium phenol, sodium phenyl-carboxylate is decomposed with the formation of disodium salicylate. In the present paper it is shown that by the absorption of carbon dioxide sodium phenol is readily converted into sodium phenyl-carboxylate, which, on heating, is completely transformed into the isomeric sodium salicylate. When sodium phenyl-carboxylate is heated with one molecule of sodium phenol, disodium salicylate and free phenol are obtained. —D. B.

Study of the Alkaloids. O. de Coninck. Bull. Soc. Chim. **43**, 236—247.

(3.) *Quinoline bases*, as observed by Williams, are polymerised by sodium; their chloroplatinates, as mentioned (*Ber.* 16, 2682), are not decomposed by boiling with water. Carbon disulphide acts very slightly on quinoline, a very small quantity of transparent crystals being produced after two or three days.

(4.) *Conine.*—Carbon disulphide readily acts on this base, producing, without evolution of sulphuretted hydrogen, a thick, yellow-brown, unpleasantly-smelling fluid. The chloroplatinate of pure conine is incompletely decomposed by boiling water, whilst the double platinum salt of commercial conine (containing methylconine) undergoes complete decomposition; the two phases of Anderson's reaction, however, do not occur. On dissolving the platinum salt of the impure base a red oil separates, which is only taken up by water on warming, and solidifies in the cold to a resinous mass.

(5.) *Nicotine.*—Carbon disulphide has no action, and the chloroplatinate is not decomposed by boiling water. The base, as shown by Etard, is oxidised by mercuric oxide, whilst β-lutidine (from brucine) and α-collidine (from cinchonine) are not attacked by this reagent.

The author compares the properties and behaviour towards chemical reagents of the pyridine bases, the alkaloids, and the quinoline bases, and adds some observations on the resinous masses obtained by the distillation of the ammonium iodides of the pyridine bases with potassium hydroxide. He further remarks that, in addition to the suffocating odour occurring in this process (Hofmann, *Ber.* 14, 1497), a red colouring matter is produced, readily recognisable on treating the product of the reaction with acidified water. The colour and the odour together serve as a test for small quantities of pyridine bases. At the conclusion of the foregoing work, the author mentions the action of sodium on piperidine, conine, and nicotine. Piperidine does not appear to be polymerised by this metal, either in the cold or at high temperatures. Commercial conine is converted into a yellow crystalline substance readily soluble in, but not decomposed by, water. Pure conine is likewise converted by sodium into a crystalline compound, from which conine is regenerated by the action of water. This difference in behaviour might serve to distinguish pure from impure conine. Nicotine submitted to the action of sodium produces, after many weeks, a solid substance, which, by contact with water, reproduces an oil having the character of nicotine.—F. L. T.

Sodium Orthovanadates and Analogous Salts. Harry Baker. J. Chem. Soc. 1885, 353.

RAMMELSBERG (*Ber.* 15, 1674) and Mendelejeff previously questioned whether the phosphates should be considered as allied to the vanadates. After Ditte (*Ber.* 18, Ref. 4) had shown that vanadium could replace phosphorus in the Apatite and Wagnerite groups, the author sought to establish the same point by the study of the orthovanadates. (1.) *Sodium orthovanadate*, $Na_3VO_4,12H_2O$.—Hitherto the only known salt was that with $16H_2O$, described by Roscoe. By fusing vanadic acid with sodium carbonate, and treating the aqueous extract of the melt with caustic soda, the vanadate crystallises in longer or shorter hexagonal prisms with basic terminations (the rhombohedron being occasionally indicated) quite analogous to the orthophosphate and arsenate. A crystal of the vanadate continues to grow in a solution of the phosphate, and a small crystal of any of the three salts causes crystallisation of supersaturated solutions of the others. In the preparation of the salt described, three other salts were obtained from the alkaline mother-liquor. (2.) *Sodium orthovanadate*, $Na_3VO_4,10H_2O$, in two modifications, the one crystallising in well-defined, clear rhombic dodecahedra, the other in thin hexagonal plates, ∞P.0P. (3.) $Na_3VO_4 8H_2O$ (?) occurs in rhombic plates. The salt can only be isolated by the mother-liquor being carefully decanted and the crystals repeatedly washed with alcohol diluted so that no precipitation occurs. The phosphates and arsenates corresponding to the last three vanadates have already been observed by the author, but not as yet prepared in any quantity. (4.) *Sodium fluovanadate*, $2Na_3VO_4,NaF,19H_2O$, is obtained either by fusing together of the corresponding amounts of vanadic acid, sodium carbonate, and sodium fluoride, and crystallising from a warm aqueous solution, or by adding the calculated quantity of sodium fluoride to a saturated solution of sodium orthovanadate, or pyrovanadate with excess of caustic soda. The salt forms clear regular octohedra, which can be recrystallised from dilute caustic soda solution. The corresponding sodium fluophosphate has been

frequently described, lastly by Rammelsberg (*Ber.* 14, 589). Sodium fluoarsenate, $2Na_3AsO_4,NaF,19H_2O$, forms shining isotropic octohedra. The author also examined the indices of refraction of the salts described.—F. L. T.

XXI.—EXPLOSIVES, MATCHES, Etc.

Magnesium for Bengal Lights. Dingl. Polyt. J. **256**, 518.

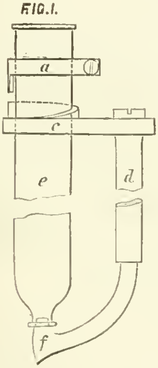
THE chemical firm late E. Schering, in a circular, recommends the following mixtures:—For white fire, 1 part shellac, fused with 6 parts barium nitrate, ground and mixed with 2·5 per cent. of magnesium powder. For red fire, 1 part shellac, 5 parts strontium nitrate, fused together, ground, and mixed with 2·5 per cent. of magnesium powder. These mixtures can be made into ribbons about a finger's breadth, or they may be charged into thin zinc tubes so as to make magnesium torches. On burning, the zinc case burns with its contents.—J. T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Apparatus for Volumetric Analysis. Dingl. Polyt. J. **256**, 502—503.

J. Greiner describes the burette shown in Fig. 1. A brass rod *d*, carried by a suitable stand, has its bottom end formed into a stopper *f*, whilst at its upper end is an arm *c*, encircling the burette and forming a screw surface. Affixed to the tube is a ring *a*, bearing a tooth *b*, Fig. 2. In using the burette the ring *a* is so fixed that the tube rests air-tight on the stopper *f*. On turning the tube the

FIG. 1.



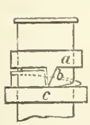


FIG. 2.

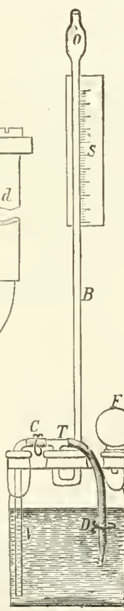


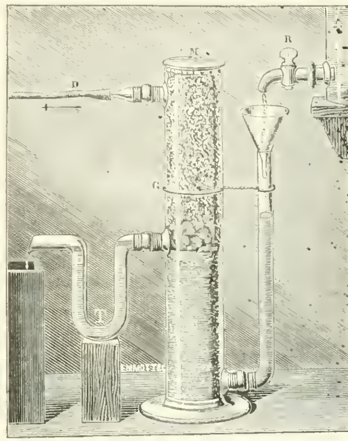
FIG. 3

tooth *b* slides up the screw path *c*, by which the tube is raised from *f*, and its contents can escape.

K. Bourdon describes a burette arrangement which requires no stand. One neck of a three-necked bottle contains a dipping tube V, Fig. 3; the second neck contains a T-tube T, which connects V, the burette B, and the jet D. On compressing the indiarubber ball F, placed in the third neck, closing the clamp D, and opening the clamp C, the burette B is filled with acid. The scale S is so placed that its zero point coincides with the top of the liquid column.—J. T.

New Laboratory Apparatus for the Continuous Production of Gas. M. Gaston Tissandier. Bull. de la Soc. Chim. de Paris, March 5, 1885.

THE forms of apparatus usually employed for the preparation of hydrogen, carbonic acid and sulphuretted hydrogen, have this serious disadvantage—viz., that the rate of production of the gas gradually diminishes as the acid employed becomes saturated with the particular salt



formed. The object the author had in view in devising the present form of apparatus was to overcome this difficulty, and to enable him to command the production of a steady stream of gas. The apparatus consists of a glass vessel, furnished with three tubulures. It is filled with the material to be acted upon from the top M, which is then covered with some impervious material. The acid, suitably diluted with water, is contained in a reservoir, and flows through the cock R, by way of the side tube A, thus entering the apparatus from below. After acting upon the material contained in the lower part of the apparatus, the acid passes away by the U-tube T. The gas generated escapes through the tube D, attached to the upper tubulure. As the material in contact with the acid becomes dissolved, its place is supplied from above. In this way a constant supply, both of fresh acid and fresh material, is maintained, and the rate of production of gas is kept perfectly constant. The rate can be regulated by controlling the flow of fresh acid by means of the cock R.—E. J. B.

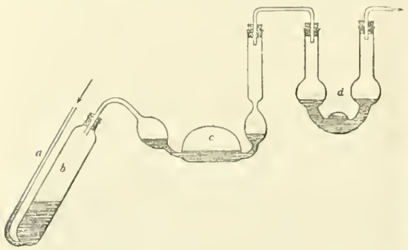
Estimation of the Halogens. G. Weiss. Rep. Anal. Chem. **5**, 238.

THE halogens must be in the state of hydracids; salts of ammonium should be avoided, and the solutions should be neutral. The tubes *c* and *d* are filled with solution of iodide of potassium; the solution or substance is placed in *b*; a gentle stream of air is passed through from *a* to *c*. A slight excess of strong solution of neutral ferric sulphate is run into *b*, and the mixture slowly raised to the boiling point. The reaction which takes place is as follows:—

$$Fe_2(SO_4)_3 + 2KI = 2FeSO_4 + K_2SO_4 + 2I.$$

The iodine carried over by the steam and air is dissolved in the iodide of potassium, and determined by the usua

method. No bromine is carried over if the solution be neutral. The residue in b is cooled, a slight excess of permanganate of potassium added, and the vessel again warmed in a water-bath to 50° to 60 C. The bromine vapour which is then evolved is drawn into and absorbed



by dilute ammonia placed in c and d, and then either volumetrically or gravimetrically determined as silver bromide. In the final residue in b the chlorine may either be directly determined or calculated from a determination of the total halogens.—T. L. B.

Iron Analysis. O. Gmelin. Chem. Zeit. 1885, 925.

Sulphur Estimation.—The sulphur is determined, after evolving it as sulphuretted hydrogen, and passing this through two U-tubes furnished with bulbs, which contain permanganate solution. Some concentrated solution of sodium carbonate is introduced into the decomposing flask before tho hydrochloric acid is added, so that the carbonic acid evolved may expel air.

Phosphorus Estimation.—The sulphuric acid solution freed from silica, is evaporated in a platinum dish, and the residue is gently ignited. After dissolving in hydrochloric acid, the phosphorus in the form of phosphoric acid is precipitated with ammonium molybdate solution, a final precipitation with magnesia mixture being made. —J. T.

The Volumetric Determination of Manganese in Alloys, Minerals, etc., by means of Potassium Chlorate. W. Hampe. Chem. Zeit. **9**, 1083.

The method has been already described by the author two years ago, and the present paper describes the results of subsequent work, considerable space being given to discussion of the observations of other experimenters. A historical notice includes the names of Rammelsberg, Wächter, Hannay, E. Thomson, Ford, Kent, Troilius, Williams and Raymond. The process consists of the precipitation of manganese as hydrated peroxide from its solution in strong nitric acid, by the addition of potassium chlorate at a boiling temperature, and the titration of the peroxide by iron salt and permanganate. The solution must not contain sulphuric or hydrochloric acids, and where these occur their removal is effected by means of barium nitrate, or by boiling with nitric acid respectively. It is essential that the solution of the metals be in nitric acid, of sp. gr. 1·4, and if the acid be weaker than this it must be boiled down until heavy white fumes are evolved, when the necessary concentration is reached. A large excess of acid is without hindrance to the reaction. In the presence of acid of less sp. gr. than 1·4, a portion of the manganese escapes precipitation by forming permanganic acid. To describe the process shortly, the solution in strong nitric acid is heated to boiling in a flask, and potassium chlorate is dropped in, a crystal at a time, as long as green vapours are evolved; when the manganese has become completely precipitated, further addition of the chlorate produces only scarcely-perceptibly coloured vapours. Five minutes' boiling is necessary to complete the precipitation. Cold water is then added to the still warm solution, and this is then quickly filtered through a paper filter, and the precipitate is washed. The precipitate is then washed off the filter into a flask, acidified iron salt solution is added, which dissolves the precipitate, and the excess of iron salt is determined by titration with permanganate. The manganese peroxide obtained by this method has constantly the composition MnO_2, on which the standard solutions used are based. The observations of Ledebur, Kent, Mackintosh, Volhard, Pattinson and Wolff, on the reaction, are noticed. In the presence of cobalt lead and bismuth, the precipitate should be dissolved in nitric acid, and a little oxalic acid, and reprecipitated as before, in order to obtain exact results. Potassium bromate does not work so well as the chlorate. Where the percentage of manganese is small, as much as 20grms. or more of substance may be used without inconvenience. A series of results obtained in presence of other metals is given to show the exactitude attainable. The treatment most convenient in special cases, as for certain alloys and minerals, is described at length. The author considers this method to equal in exactness and universal application the phosphoric molybdic reaction.—G. H. B.

New Books.

HANDBOOK OF TECHNICAL GAS ANALYSIS, CONTAINING CONCISE INSTRUCTIONS FOR CARRYING OUT GAS-ANALYTICAL METHODS OF PROVED UTILITY. By CLEMENS WINKLER, Ph.D., Professor of Chemistry at the Freiberg Mining Academy. Translated with a few additions by GEORGE LUNGE, Ph.D., Professor of Technical Chemistry at the Federal Polytechnic School, Zurich. London: John Van Voorst, 1, Paternoster Row, 1885.

LARGE 8vo volume, bound in cloth, containing Translator's and Author's Prefaces, Table of Contents, Introduction, subject matter covering 122 pages, and an Alphabetical Index. The work is illustrated with 55 well-executed woodcuts. The subject matter is subdivided as follows:—Chapter I. On taking Samples of Gases. II. On the Measurement of Gases. III. Apparatus and Methods for carrying out the Analysis of Gases. (i.) Estimation of Gases by Absorption. (ii.) Estimation of Gases by Combustion. (iii.) Gas Analysis and Gas-volumetrical Analysis by means of Lunge's Nitrometer. An Appendix which completes the work, contains a series of useful Tables for Reference and Employment in the Calculations involved in the Analytical Operations.

THE ART OF SOAP-MAKING. A PRACTICAL HANDBOOK OF THE MANUFACTURE OF HARD AND SOFT SOAPS, TOILET SOAPS, ETC. Including many NEW PROCESSES, and a Chapter on the RECOVERY OF GLYCERINE FROM WASTE LEYS. By ALEXANDER WATT. [Second Edition, carefully revised.] London: Crosby, Lockwood & Co., 7, Stationers' Hall Court, Ludgate Hill, 1885.

OCTAVO volume, bound in cloth, containing Preface, Table of Contents, and 228 pages of subject matter, followed by an Alphabetical Index. The work is illustrated by 36 woodcuts, and the Chapters are divided as follows:—Chap. I. Saponification Explained. II. The Soap Factory—its Apparatus and Appliances. III. Materials used in Soap-making. IV. Caustic Leys. V., VI. and VII. Manufacture of Hard Soaps. VIII. Making Soap by the Cold Process. IX. Oleic Acid—Soap from Recovered Grease. X. and XI. Cheapened Soaps. XII. Disinfecting Soap. XIII. Saponification under Pressure. XIV. Various Processes. XV. and XVI. Manufacture of Soft Soaps. XVII. Manufacture of Toilet or Fancy

Soaps. XVIII. and XIX. Manufacture of Toilet Soaps. XX. Soft Toilet Soaps. XXI. Medicated Soaps. XXII. Miscellaneous Soaps. XXIII. Miscellaneous Processes. XXIV. Alkalimetry—Methods of Determining the Percentage of real Alkali in Potash, in Commercial Soda-ash, Potash, and Caustic Alkali. XXV. Methods of Analysing or Assaying Soaps. XXVI. Purifying and Bleaching Oils and Fats. XXVII. Recovery of the Glycerine from Waste or Spent Leys. XXVIII. Useful Notes and Tables.

A TEXT-BOOK OF TANNING: A TREATISE ON THE CONVERSION OF SKINS INTO LEATHER, BOTH PRACTICAL AND THEORETICAL. By HENRY R. PROCTER, F.C.S., of Lowlights Tannery, Examiner in Tanning to the City and Guilds of London Institute. London: E. & F. N. Spon, 125, Strand. New York: 35, Murray Street. 1885.

THIS 8vo volume, well bound in cloth, contains 274 pages of subject matter and an alphabetical index. It is illustrated by eight photographic plates, and with 67 well-executed wood-cuts.

Though the name of Mr. Procter, as the author of the work, is a guarantee for the practical value of the information given, yet a summarised list of the subdivision of the text into chapters will indicate the mode of treatment followed, and the compass of that treatment.

Chapter I. Anatomical Structure of Hide. II. Chemical Composition of Hide. III. Commercial Tanning Materials. IV. The Chemistry of Tannins. V. Water as used in Tanning. VI. Methods of Chemical Analysis for the Tannery. VII. to XI. Sole-leather—Preparing the Hides—Unhairing Hides—Tanning Materials—Treatment in the Tan-house—Treatment in the Shed. XII. Dressing Leather. XIII. Currying. XIV. Enamelled, Patent, or Japanned Leather. XV. Morocco Leather. XVI. Russia Leather. XVII. Chamois or Wash-leather. XVIII. Crown Leather, or Preller's Leather. XIX. Mineral-tanned Leather. XX. Calf-kid. XXI. Glove-kid. XXII. Construction and Maintenance of Tanneries. XXIV. Commerce, Statistics, and Bibliography.

Chapter XXIV. is very carefully compiled by Mr. C. G. Warnford Lock, as well as Chapter III. From the list of works of reference we miss, however, the name of the *Journal of the Society of Chemical Industry*, with its special Chapter XIII. devoted to Tanning, Leather, etc., and the valuable paper of Mr. W. J. A. Donald, on the Chromate Process of Tanning, *J. Soc. Chem. Ind.* vol. iii. p. 615.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

12484 A. Brin, London. An improved refractory substance or material suitable for lining furnaces, or for other purposes where a material capable of withstanding a high temperature is required. October 19

12892 J. C. Mewburn, London—Communicated by C. C. Peck, France. Improvements in distilling and concentrating liquids, and apparatus therefor. October 27

12997 A. Stewart and C. Stewart, Glasgow. Improvements in the fittings and application of injectors for burning liquid fuel in furnaces for generating steam, smelting and melting metals, consuming smoke, and similar purposes. October 29

13089 T. B. Lightfoot, London. Improvements in machinery or apparatus for refrigerating or producing ice. October 30

13250 W. Jarvis, Banbury. Pumps for liquids or fluids. November 3

13272 J. W. Holden, London. Improvements in apparatus for economising fuel and consuming smoke in, and otherwise increasing the steam generating properties of boilers, partly applicable to ventilating purposes. November 3

13166 E. Solvay, Liverpool. New or improved apparatus for, and process for producing, applying, and keeping up extreme temperatures. Complete specification. November 6

13583 B. H. Remmers and J. Williamson, Glasgow. Improvements in tubular heating and cooling or condensing apparatus. November 9

13779 F. B. Welch, Manchester. Apparatus for grinding or reducing solid materials, and for mixing fluids or semi-fluids therewith. November 12

13799 L. H. Pearce, London. Improvements in distilling liquids and in apparatus therefor. November 12

13859 J. G. Robinson, Halifax. An improved construction of regenerative or recuperative furnace, applicable to gas, iron, steel, glass or other furnace. November 13

II.—FUEL, GAS, AND LIGHT.

12510 H. M. Morrison, London—Communicated by J. G. Hathaway, United States. Improvements in apparatus for pulverising fuel and feeding it to furnaces or fires for combustion therein. October 20

12599 F. Vernon Hadlow, Buxted. An improvement in the artificial manufacture of coal, so as to render it comparatively smokeless. October 21

12602 H. Harrison, London. Improved apparatus for regulating the supply of gas. October 21

12633 H. Harris, London. Purification of gas in its passage direct from the meter previously to its entering into the service pipes, thereby improving the illuminating power and economising the consumption and smoke therefrom. October 22

12644 F. J. Jones, London. Improvements in gas producers, and a method for securing the complete combustion of gases in boiler and other furnaces. October 22

12686 S. F. Smith, London. Carrying off the products of combustion from gas and other lights. October 23

12721 J. Lucas Balfour and J. Lane, London. Improvements in the manufacture of illuminating gas and volatile liquid hydrocarbons. October 23

13003 J. Murray, Glasgow. An improved method of creating a current of air in combustion apparatus, and applying the products of combustion to vapour generators. October 29

13040 R. Mitchell and R. B. Main, Glasgow. Improvements in open gas fires. October 29

13061 J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery or apparatus for the manufacture of artificial fuel. October 30

13067 J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery or apparatus for the manufacture of artificial fuel. October 30

13071 W. Armitage, Sheffield. Improvements in apparatus for smoke burning. October 30

13073 J. A. B. Bennett and G. E. Wright, King's Heath. Improvements in apparatus for mixing and burning gases. October 30

13164 S. A. Sadler, London. Improvements in the method of, and apparatus for, absorbing benzol or other hydrocarbon liquids into illuminating gas. October 31

13312 C. A. von Welsbach, London. A novel illuminating substance for incandescent gas burners. Complete specification. November 4

13360 C. Hunt, Westminster. Improvements in ascension pipes used in the manufacture of gas. November 1

13117 G. A. Sweetser, D. W. Bell, and W. Bohn, London. Improvements in the manufacture of candles and apparatus therefor. November 5

13530 T. A. Greene and C. M. Walker, London. Improvements in regenerative gas lamps. November 7

13560 R. Walker, Sunderland. Consuming oil as fuel. November 9

13567 G. Anderson, Spennymoor, Durham. An improved apparatus for the distribution of gas and air in regenerative steel-melting, glass-melting, and other furnaces wherein gaseous fuel is used for heating the same. November 9

13597 T. Rouet, London. The manufacture and employment of grease-proof cases for holding solid albo-carbon in stick, rod, or pellet form, as charge cartridges for easy insertion into albo-carbon lamps. November 9

13621 A. Wright, London. An improved manufacture of medicated candles, night-lights, lamp oils, and the like. November 10

13631 H. J. Allison, London—Communicated by R. P. Ambler and H. Deitz, United States. Improvements in apparatus for making and burning gaseous fuel. Complete specification. November 10

13728 A. Gutensohn, London. An improved fire-lighter, suitable also for use as artificial fuel. November 11

13967 J. Roots, London. Improved method and apparatus for rendering a liquid hydrocarbon gaseous. November 16

13980 D. W. Sugg, London. Improvements in apparatus for lighting by gas. November 16

13981 J. Ashworth, London. Improvements in means for utilising heat, consuming smoke, and economising fuel in furnaces. November 16

13983 J. Shaw and N. Arthur, Glasgow. Improvements in apparatus for feeding fuel to, and promoting draught and combustion in, furnaces. Complete specification. November 16

13990 J. G. Penn, London. Improvements in the manufacture of compound fuel. November 16

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

13014 N. M. Henderson, Glasgow. Improvements in apparatus for distilling shale or other mineral oil or petroleum. October 29

13096 A. Morton and J. Fyfe, Glasgow. Improvements in furnaces for distilling and refining mineral oils. October 30

IV.—COLOURING MATTERS AND DYES.

13108 The Leipziger Anilinfabrik Beyer and Kegel, London. Production of new colouring matters. November 5

13801 L. A. Groth, London—Communicated by G. Link, Germany. A new or improved process for purifying naphthaline by the use of soap. November 12

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

13301 E. H. Hargraves, Manchester. Improvements in the method of, and apparatus for, treating cotton or other fabrics, so as to produce therein a greater amount of softness or flexibility. November 4

13380 F. Sutcliffe, Manchester. Improved apparatus for treating cotton, wool, or other fibrous substances in the process of manufacture. November 5

13531 H. J. Haddan, London—Communicated by Löwinger and Knöpflmacher, Austria. Process for waterproofing woollen and other fabrics. November 7

13533 C. D. Abel, London—Communicated by F. C. Glaser, Germany. An improved manufacture of textile or other fabrics with designs or patterns marked thereon, to facilitate the cutting out of the fabric according to the said patterns or designs. Complete specification. November 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

12531 J. H. Ashwell, Liverpool. Improvements in apparatus applicable for dyeing, scouring, and other like purposes. October 20

13029 T. Salt, Saltaire. Improvements in apparatus for use in dyeing or treating woven fabrics. October 29

13030 Sir T. Salt, Bart., Sons & Co., and R. Pearson, Saltaire. Improvements in apparatus for use in dyeing or treating woven fabrics. October 29

13137 Sir T. Salt, Bart., Sons & Co., and T. Salt, London. Improvements in apparatus for use in dyeing or treating woven fabrics. October 31

13214 W. R. Lake, London—Communicated by V. Gaillot, France. Improvements relating to the dyeing of silk, wool, and other substances. November 2

13263 A. M. Clark, London—Communicated by L. Pfaff, United States. Improved dyeing apparatus. November 3

13436 J. Apsley and E. Lumb, London. A new or improved aërated bleaching liquor for bleaching linen; and apparatus for manufacturing the same. November 6

13437 J. Apsley and E. Lumb, London. A new or improved method of bleaching cotton, linen, velvets, etc.; and chemical compounds and apparatus therefor. November 6

13790 T. Holliday, London. Improvements in the production of azo colours on cotton or other vegetable fibre. Nov. 12

VII.—ACIDS, ALKALIS, AND SALTS.

12314 J. Webster, London. A process for the utilisation of waste liquors or tank-waste containing calcium chloride. Complete specification. October 16

12745 W. R. Lake, London—Communicated by T. Schmidtborn and D. Jarves, United States. An improved process for the manufacture of ammonium chloride and potassium sulphate. Complete specification

13082 J. Gibson, Glasgow. Improvements in decomposing and utilising the products of decomposition of common salt. October 30

13099 J. G. Chapman and R. Foote, London. Improvements in apparatus for generating carbonic acid gas. October 30

13108 J. Y. Johnson, London—Communicated by C. Dubois, France. Improvements in extracting sulphur from materials employed in the purification of gas or from other materials containing sulphur. October 30

13462 J. B. Spence, London. Improvements in the manufacture of sulphide of zinc. November 6

13950 P. Hart, Manchester. Improvements in the manufacture of the sulphites and bi-sulphites of the alkalis and alkaline earths. Complete specification. November 16

13995 H. H. Lake, London—Communicated by The Verein Chemischer Fabriken, Germany. An improved process of extracting ammonia and chlorine from lyes containing ammonium chloride. November 16

VIII.—GLASS, POTTERY, AND EARTHENWARE.

12762 J. Clark Belfield, Prestonpans. A furnace for burning dross or slack in the firing of all kinds of earthenware, bricks, pipes, tiles, etc., also applicable to steam-boilers, etc. Oct. 21

12814 J. Wilson, Glasgow. A new or improved process of preparing or treating fire-clay for potters' use. October 26

13394 J. Rogers, Truro. Improvements in drying china clay, china stone, ochre, amber, etc. November 5

13561 F. D. Bradley and H. Snow, Longton. Improvements in the manufacture of china, earthenware, pottery, and glass, more especially as to the ornamentation in the body thereof. November 9

13592 L. J. Murray, London. Improvements in the manufacture of glassware. November 9

13685 W. R. Lake, London—Communicated by T. W. Synnott, United States. Improvements in and relating to glass furnaces. Complete specification. November 10

13910 E. M. Knight, Halifax. Improvements in blown glass bottles and in stoppers for same, and in apparatus employed in the manufacture of such bottles and stoppers. Nov. 14

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

12328 R. Bristow Lee, Manchester. Improvements in the construction of fire-proof pillars and columns. October 16

12383 A. Campbell Ponton, Parkstone, Dorset. Improvements in the manufacture of artificial stones and concretes. October 17

12390 J. S. Armstrong, St. John, Canada. Improved forms of building materials. October 17

12391 H. Wiesen, London. Improvements in the manufacture of bricks for building purposes. Complete specification. October 17

12405 J. J. Allen, Leeds. Improvements in machinery employed in the manufacture of bricks and tiles from plastic materials. October 17

12505 W. T. Allen, Erdington. The use of earthenware in place of bricks, cement, slate, or stone, in the construction of self-flushing water-closets. October 20

12523 H. H. Redfern, Hanley, Staffordshire. Calcining flints, felspar, stone, lime, and other materials. October 20

12563 T. Castle, London. Improvements in the manufacture of cement, and in machinery and kilns to be used in this manufacture. October 20

12568 W. R. Lake, London—Communicated by L. Brown, United States. Improvements in and relating to the manufacture of pigments, paints, cement, bricks, and other substances and articles from iron ore. Complete specification. October 20

12725 H. Blythe, London. Improvements in the manufacture of bricks to avoid side and end straight joints. October 23

12841 W. R. Lake, London—Communicated by J. P. E. Durst and L. Vidric, Hungary. Improvements in apparatus for impregnating wood with preservative and other fluids. Oct. 26

12908 S. Pitt, Sutton—Communicated by A. Speyser and L. Pillivuyt, France. Improvements in the manufacture of lime cement, applicable to the production of cements, mortars, and hydraulic concretes, and artificial stone. October 27

12920 C. J. Howe, London. Improvements in the manufacture of Keene's cement. October 27

13294 H. H. Lake, London—Communicated by J. H. Young, United States. Improvements relating to the preparation and treatment of wood for the preservation of the same, and apparatus therefor. Complete specification. November 3

13326 W. Whitwell, J. E. Swindell, and W. B. Collis, Stourbridge. Improvements in kilns or chambers for burning and drying bricks, and for other purposes. Complete specification. November 4

13328 T. Smith, London. A new or improved combination of materials for making cements, capable also of being used for other useful and ornamental purposes. November 4

13595 A. G. Brookes, London—Communicated by R. A. Meyn and J. F. O. Armack, Germany. Improvements in manufacturing artificial stones or marbles. November 9

13699 W. Keller, London. Improvements in the manufacture of cement or mortar. Complete specification. November 10

13731 O. L. Mauroit, Liverpool. Improvements in the manufacture of cement from blast furnace slag and other materials, and apparatus therefor. November 11

13766 W. H. Lindsay, London. Improvements in fire-proof floors. November 11

13840. T. Hunter and J. G. Brown, Cardiff. Improvement in design for making and setting (in water) cement concrete blocks. November 13

X.—METALLURGY, MINING, Etc.

12355 W. Edmunds, London. Improvements in blast furnaces. October 16

12485 F. W. Koppler and E. Zwierzina, London. Improvements in the process of and means for zincing or coating sheet metal with zinc. October 19

12501 J. W. Summers and T. Sharp, Stalybridge. Improvements in working light scrap iron or other material in making iron or steel bars. October 20

12615 G. Allan and T. Turner, London. Appliances for producing ingots compounded of iron and steel. October 21

12616 G. Allan and T. Turner, London. A process for manufacturing variegated metal for twist barrels and such like purposes. October 21

12756 J. Riley, Glasgow. Improvements in and connected with regenerative steel-making furnaces. October 21

12760 J. Riley and W. Crossley, Glasgow. Improvements in and connected with furnaces for melting or treating iron, steel, ores, or other substances. October 21

12795 T. Turner, London. Improvements in and moulds for casting ingots and other articles of steel and other metals. October 21

12823 W. C. Stiff and H. B. S. Bennett, London. Improvements in the manufacture of tubes and ordnance of steel and iron. October 26
12891 J. E. Sherman, London. Improvements in the manufacture of iron and steel. October 27
12905 A. Watt, Battersea. Improvements in colouring metals. October 27
12909 S. Pitt, Sutton—Communicated by J. Weirich, France. Improvements in the treatment of auriferous and auro-argentiferous minerals. October 27
13051 C. A. Faure, St. Brice, France. Improvements in the manufacture of the metals of the alkalis and alkaline earths. October 29
13221 E. Young, Dulwich. Improvements in the manufacture of iron and steel. November 3
13241 T. H. Johns, London. Improvements in tinning and finishing tin plates. Complete specification. November 3
13260 L. Kleeman. London. Improvements in furnaces for smelting zinc ores or other materials containing zinc, and in the mode of operating therewith. November 3
13275 W. Deighton, Sheffield. Improvements in furnaces, apparatus, and appliances connected therewith, for melting and treating ores, metals, and the like substances. Nov. 3
13280 W. H. Watson, Liverpool. Improvements in or relating to the treatment of certain substances containing alumina or iron, or both. November 3
13368 T. Davage, jun., London. An improved method of and apparatus for turning ingots of steel, iron, or other metals during the process of forging. November 4
13410 T. B. Sharp, London. Improvements in the manufacture of tubes of copper and of certain alloys of copper. Nov. 5
13628 J. A. Crane, Birmingham. Improvements in the production of iron and steel tubes. November 10
13630 R. Savage, London. Certain improvements in apparatus for making moulds and cores of sand. Complete specification. November 10
13634 J. Riley and W. Crossley, Glasgow. Improvements in compound furnaces for making steel. November 10
13763 W. H. Lindsay, London. Improvements in the manufacture of corrugated plates of metal. November 11
13860. J. Pickering, Glasgow. Improvements in cast steel forgings. November 13
13892 C. Cheary, London. Improved processes and apparatus for the treatment of ores. November 13
13931 W. R. Lake, London—Communicated by MM. Demange et Satre, France. An improved machine or press for the manufacture of lead pipe. November 14
13939 D. Davy and A. B. Baylis, London. Improvements in puddling and heating furnaces. November 14
13982 W. F. Richards, London. Improvements in the production of metallic zinc. November 16

XI.—FATS, OILS, AND SOAP MANUFACTURE.

12192 A. Twistleton Hall, London. Extracting oils from certain waste products. October 19
12822 J. Thomson, London. Obstetric soap. October 26
13303 T. J. Flynn, Manchester. Improvements in oxidising linseed-oil to be used in the manufacture of linoleum or other coverings for floors. November 4
13361 A. T. Hall, London. Improvements in refining vegetable oils. November 4
13922 G. W. Bremner, London. A new or improved method of treating materials for the manufacture of washing liquids and cleansing powders. November 14

XII.—PAINTS, VARNISHES, AND RESINS.

12537 R. Merrin, Liverpool. New or improved coverings or coatings for propeller blades and other surfaces exposed to corrosive action. October 20
12568 W. R. Lake, London—Communicated by L. Brown, United States. Improvements in and relating to the manufacture of pigments, paints, etc., from iron ore. Complete specification. October 20
12723 T. Childs, Huntington, and M. Chiapponi, London. An improved method of treating antimonial ores or compounds for the production of pigment. October 23
12780 J. C. Mewburn, London — Communicated by J. L. Martiny et Cie., France. An improved manufacture of non-conducting material for covering steam-boilers, steam-pipes, hot or cold water pipes, and for other like purposes. Complete specification. October 24
12891 A. W. Anderson, London. Improvements in apparatus for facilitating the dissolution of oxide of lead and other substances for making lead salts for the manufacture of white lead and other compounds of lead. October 27
13115 J. Haylor, H. S. Read, and H. G. Percival, London. Apparatus for the manufacture of white lead. October 30
13159 J. Pointon, Liverpool. Improvements in anti-fouling and anti-corrosive paints or compositions. October 31
13221 J. Boam, London. An improved method of treating iron ores, oxides of iron, and other like materials to be used in the manufacture of paints, colours, and the like. November 2
13396. E. Jackson, Liverpool. New or improved composition or paint, applicable for coating ships' bottoms and other structures. November 5
13472 A. Mackay and M. Mackay, London. Improvements in treating copal, kauri, sandrac, and other gum resins. November 6
13479 E. Edwards, London—Communicated by M. Schauenberg, Belgium. An improved blacking. November 6
13877 G. W. Bremner, London. A new or improved method of operating on animal or mineral material for the manufacture of a paint suitable for ships' bottoms and other submerged bodies. November 13
13891 J. B. Freeman, London. An improved white pigment. November 13

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

13084 J. Vassie, jun., Glasgow. Improvements in operating the tables of leather-dressing and hide-working machines. October 30
13134 J. Vassie, jun., Glasgow. Improvements in leather-dressing and hide-working machines. October 31
13259 G. L. Fevre and C. Tissier, London. A process for tanning, currying, and finishing skins. November 3
13856 G. W. Bremner, London, A new or improved treatment of substances containing phosphoric acid and alumina for the manufacture of mineral gums and glue therefrom. November 13

XV.—SUGAR, STARCH, GUMS, ETC.

12871 W. R. Lake (F. O. Matthiesen). Improvements in and relating to bone-black filters. Complete specification. Oct. 27
12874 W. R. Lake, London—Communicated by F. O. Matthiesen, United States. An improved process of and apparatus for the purification and decolourisation of sugar. Complete specification. October 27
12875 W. R. Lake, London—Communicated by F. O. Matthiesen and E. E. Quimby, United States. Improvements in apparatus for decolourisation of saccharine or other liquor. Complete specification. October 27
12876 W. R. Lake (F. O. Matthiesen). Improvements in apparatus for the filtration of sugar liquor. Complete specification. October 27
12877 W. R. Lake (F. O. Matthiesen). Improvements in and relating to bone-black filters for filtering sugar liquor. Complete specification. October 27
12878 W. R. Lake (F. O. Matthiesen). Improvements in apparatus for effecting the decolourisation of sugar liquor. Complete specification. October 27
12879 W. R. Lake (E. E. Quimby). Improvements in and relating to apparatus for effecting the decolourisation of sugar liquor. Complete specification. October 27
13792 A. Crum Ewing, Glasgow — Communicated by T. Shields, British Guiana. A combined eliminator and filter for treating sugar-cane juice and other liquids. November 12

XVI.—BREWING, WINES, SPIRITS, ETC.

12163 W. Stevens Squire, London. Improvements in the manufacture of yeast. October 19
12672 J. J. Cornish, London. Improvements in or applicable to tiles for forming the floors of malt and other kilns. Complete specification. October 22
12679 A. M. Clark, London—Communicated by W. Thue, United States. An improved process of preserving brewers' and other grains. October 22
12773 A. F. Vuylsteke, London. Improved yeast press. October 24
12916 A. G. Fraser and G. Epstein, London. Improvements in the preparation of yeast. October 27
12919 A. G. Fraser and G. Epstein, London. Improvements in the purification of yeast. October 27
12950 E. Eggett, London. Yeast. October 28
13006 H. J. H. King, Newmarket. Improvements in automatically regulating the temperature of malt and hop kilns, and indicating the same. October 29
13203 A. G. Southby, London. Improvements in treating beer, and apparatus connected therewith. November 2
13217 A. G. Fraser and G. Epstein, London. Improvements in the treatment of distillers' worts, to separate yeast therefrom. November 2
13616 A. Z. Champy, A. N. Champy, and L. P. Champy, London. Improvement in the treatment of Jerusalem artichoke, to prepare it for use in distilling, in the manufacture of glucose and similar industries. November 9
13643 P. Robinson, London. Improvements in brewers' aerators, rousers, and mixers, suitable for fermenting vessels, and for other analogous purposes. November 10
13738 H. J. Haddan, London—Communicated by C. Ross, Germany. Process for preventing the formation of deposit in Pasteurised beer. November 11
13882 J. R. Thame and T. Blake, London. An automatic heat indicator, for use in breweries and other places. Nov. 13

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

(A) *CHEMISTRY OF FOODS.*

12451 A. Jones, London. Improvements in medicating saccharine and farinaceous substances ordinarily used as food. October 19
12917 H. C. Johnson, London. Process and apparatus for dehydrating and refrigerating air for the transportation of meat, etc. October 27
13052 T. Dence and J. J. Mason, London. Improvements in the manufacture of artificially digested food. October 29
13573 M. Closset, Paris. An improved process for preserving meat and like substances. November 9

(B) *SANITARY CHEMISTRY.*

12188 W. Corry Dickenson, London. Improvements in filters for the purification of water, by the manufacture and employment of cartridges for charging and recharging filters. October 19

12513 P. Parker, Keighley. Improvements in the construction of water filters. October 20

12662 J. Greenwood, London. An automatic disinfecting apparatus. October 22

12674 H. N. Crellin, London. Improvements in the treatment and disposal of sewage. October 22

12731 A. Gordon Salamon, London. Improvements in the manufacture of filtering materials. October 23

12895 H. Fewson, Buckingham. Treatment of blood in slaughter-houses (public or private). October 27

13281 W. H. Watson, Liverpool. Improvements in the treatment of sewage, dye-waters, or similar liquid refuse. November 3

13423 A. Patrick, Glasgow. Improvements in earthenware pipes for sewage or other liquids. November 6

13511 T. Archer, jun., London. An improved means or apparatus for effecting the filtering or purifying of water on its passage from one place or vessel to another. November 7

13587 A. A. Common, London. Improvements in the disposal of sewage. November 9

13641 J. C. Kent, London. Improvements in and apparatus for automatically discharging any given quantity of disinfecting or other fluid into flushing tanks or other receptacles. November 10

13660 W. C. Dickenson, London. Improvements in filters for the purification of water, which are instantly cleansed with filtered water without being taken to pieces. Nov. 10

13719 W. C. Sillar and The Native Guano Co., London. Improvements in the treatment of sewage and other liquid or semi-liquid putrescent or putrescible matters. November 11

13750 J. W. Slater and The Native Guano Co., London. Improvents in the preparation of agents to be used in the treatment of sewage and other liquid or semi-liquid putrescent or putrescible matters, and improvements in the treatment of such matters. November 11

13761 G. W. Bremner, London. A new or improved treatment of chemical agents and the employment of the resultant for the precipitation, clarification, and defecation of sewage matters. November 11

(C) *DISINFECTANTS.*

12985 W. D. Borland, London. Obtaining granulated antiseptic preparations. October 28

XVIII.—ELECTRO-CHEMISTRY.

12378 A. Schanschieff, London. Improvements in galvanic batteries, and in the preparation of liquids to be used in such batteries. October 16

12428 O. Gee Pritchard, London. Improvements in the manufacture of carbons for electric arc lamps. October 17

12545 A. W. Armstrong, Lewisham. Improvements in or connected with porous cells, sections, and plates for electrical purposes. October 20

12562 J. Rettie and J. B. Garnham, London. Improvements in battery plates for electrical purposes. October 20

12606 W. H. Scott and E. A. Paris, London. New or improved electrical apparatus for governing or regulating electric currents. October 21

12721 J. Evelyn Liardet, London. Improvements in galvanic or primary batteries. October 23

12906 A. Watt, Battersea. Improvements in the electrolytic colouration of metals. October 27

12984 N. de Benardos, and S. Olszewski, London. An improved method of and apparatus for the working of metals and metalloids by the direct application of electric currents. October 28

13036 A. Bernstein, London. Improvements in the manufacture of carbons for incandescent lamps. October 29

13207 E. Martin, London. An improved manufacture of metal wire for electrical transmission and other purposes. November 2

13266 L. A. Groth, London, Communicated by R. Vogler, Germany. A new or improved dynamo electric machine. November 3

13313 S. P. Thompson, London. Improvements in constant current dynamo electric machines. November 4

13422 W. A. Barlow, London—Communicated by M. Sappey, France. A new or improved electric generator, with automatic feed. November 5

13451 E. G. Colton, London—Communicated by F. Haenichen, O. Haenichen, and O. Seebass, United States. Improved method of neutralising the residual magnetism in electromagnets. Complete specification. November 6

13639 W. Maxwell, London. Improvements in the manufacture of carbon filaments for incandescent lamps. November 10

13951 G. Tolman and H. Denton, Wolverhampton. Improvements in dynamo electric machines. November 16

XIX.—PAPER, PASTEBOARD, Etc.

12610 F. G. Morton, and N. Salamon, London Improvements in the manufacture of pulp, millboard, and brown paper, utilising certain waste materials. October 21

12772 J. Raper Thame, London. Improvements in rendering paper and similar materials impervious to water, acids, and other liquids. October 21

12816 N. Brown, London—Communicated by H. Pitzler, Germany. Improvements in machinery for making paste-board and for spreading adhesive and fluid or semi-fluid substances for other purposes. October 27

13022 F. G. Morton, and N. Salamon, London. Improvements in the manufacture of pulp or "half-stuff," utilising waste or refuse materials. October 29

13505 W. H. Akester and R. R. Kelly, London. Manufacture of material suitable as a substitute for cork. November 7

13506 W. H. Akester and R. R. Kelly, London. Improvements in treatment of paper or other fabrics, textile or otherwise, with dissolved nitro-cellulose, adaptable for various purposes. November 7

13969 A. B. O'Connor, London. Improvements in the preparation and treatment of paper and other pulps for the purpose of rendering the same waterproof. November 16

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

13813 J. Grossmann, Manchester. Improvements in or appertaining to the manufacture of prussic acid and its compounds. November 13

XXI.—EXPLOSIVES, MATCHES, Etc.

12450 F. W. Ticehurst, Birmingham. A new or improved instrument or apparatus for determining and indicating the comparative strengths of powder charges. October 19

12778 O. Imray, London—Communicated by R. Bernstein, Germany. Manufacture of granular nitro-cellulose. October 24

12837 H Imray, London—Communicated by H. Dulitz, Germany. Manufacture of an explosive compound. October 26.

13581 B. H. Remmers and J. Williamson, Glasgow. An improved manufacture of gunpowder. November 9

13582 B. H. Remmers and J. Williamson, Glasgow. Improvements in the manufacture of gunpowder, and in the treatment or preparation of carbonaceous materials therefor. November 9

13690 H. H. Lake, London—Communicated by C. Lunn, Sweden. An improved explosive compound. November 10

13938 R. Bell, London. An improvement in wax matches and vesta-fusees. November 14

XXII.—ANALYTICAL CHEMISTRY.

13050 F. Lux, London. An improved method of ascertaining the specific gravity, the pressure, and the component parts of fluids. Complete specification. October 29

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1885.

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1885.

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1885.

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X.—METALLURGY, MINING, Etc.

1884.

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1885.

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1884.

11700 W. P. Thompson—Communicated by M. Julien and M. Blumski. Distillation of fatty substances by means of superheated steam, and apparatus therefor. 6d
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XII.—PAINTS, VARNISHES, and RESINS.

1885.

312 J. S. Gisborne. Anti-fouling and preservative composition or paint for coating ships' bottoms, etc. 4d
9111 W. Macrone. Manufacture of dry colours. 2d
9113 W. Macrone. A new or improved varnish or size. 2d
9119 T. Harrison. Coating the insides or outsides of iron and steel ships, etc., where the preservation of iron, steel, or other metal is desirable. 2d

XIV.—AGRICULTURE, MANURES, Etc.

1885.

5227 C. Lehofer. Treatment of human excrements, sewage and similar matter for the manufacture of manure. 6d

XV.—SUGAR, STARCHES, GUMS, Etc.

1885.

4948 W. R. Lake—Communicated by W. T. Jebb. Improved starch-meal. 6d
4954 W. R. Lake—Communicated by W. T. Jebb. Improvements in the manufacture of starch-meal. 6d
10172 P. Jensen—Communicated by M. C. P. Barbe. Manufacture of refined sugar, and apparatus therefor. 6d

XVI.—BREWING, WINES and SPIRITS.

1884.

16043 E. T. Pemberton. Brewing or producing ale and porter. 4d

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(B) *SANITARY CHEMISTRY.*

1884.

16705 A. Howatson. Apparatus for treating water with lime or other matter for the purpose of purifying the said water. 6d
16706 A. Howatson. Apparatus for separating solid impurities from water or other liquid. 8d

1885.

7352 B. L. Ryder. Method and apparatus for desiccating vegetable and animal matter. 6d

(C) *DISINFECTANTS.*

1884.

16427 J. Jeyes. An improved disinfecting compound. 4d

XVIII.—ELECTRO-CHEMISTRY.

1881.

16554 A. M. Clark—Communicated by P. Moebius. Apparatus and process for the electrolytical separation and deposition of metals. 10d

XIX.—PAPER, PASTEBOARD, Etc.

1885.

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9411 W. Macrone. Waterproofing paper, etc., and machinery therefor. 4d

9412 W. Macrone. Machinery for varnishing or sizing and applying colours to paper and other fabrics. 6d

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

1885.

11258 D. D. Cattanach. Method and apparatus for the manufacture, distillation, and concentration of alcohol, hydrocarbons, and acetic acids. 8d

XXI.—EXPLOSIVES, MATCHES, Etc.

1884.

13475 G. G. André. Explosive compounds. 4d

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1885

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W. Virtue, l/o Glasgow; Kngl. Landwirtschaftlichen Schule, Weihanstephan, Bavaria.

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Oswald D. Cottell, 101, Long Lane, Bermondsey, S.E., vinegar manufacturer.
Francis J. H. Coutts, 61, East View, Turton Road, near Bolton, chemical bleach works.
Percy R. Crompton, Dearden's House, Bury, Lancashire, paper manufacturer and chemist.
Chas. Deakin, Egerton, near Bolton, Lancashire, dyer.
Wallace Fairweather, 135 Buchanan Street, Glasgow, engineer and patent agent.
Jno. Hatfield, Windsor Road, Newton Heath, Lancashire, bleacher and dyer.
C. T. Heycock, M.A., King's College, Cambridge, lecturer on chemistry.
Z. George Heys, Springhill Villa, Barrhead, near Glasgow, calico printer.
Harold Imray, Lonmay, East End Road, Finchley, N., patent agent.
F. W. T. Krohn, 13, Belsize Square, South Hampstead, N.W., chemist.
J. T. Leon, 26, Belsize Park Gardens, South Hampstead, N.W., chemist.
Alf. Lundberg, Bergvik, Sweden, chemical engineer to wood pulp works.
H. Forster Morley, University Hall, Gordon Square, W.C., assistant professor of chemistry.
E. Perrett, 8, Victoria Chambers, Westminster, S.W., civil engineer.
Fred. W. Shaw, Heapey Bleach Works, near Chorley, analyst.
John Shaw, Bradley Mills, Halifax, paper maker.
E. Snelling, 5, Spital Square, Bishopsgate Street, E., brewer.

Death.

Nov. 26, Alfred Tribe, 14, Denbigh Road, Bayswater, W.

ERRATUM.—On page 575, left column, line 23, insert the words "a large bottle" after the word "chamber."

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer, Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885—86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

January 4, 1886.—Mr. G. E. Davis, F.I.C.—"On the Enrichment of Coal Gas by certain Hydrocarbons." Mr. C. T. Kingzett—"Notes on Russian Turpentine."

February 1.—Mr. Gustav Bischof—"Notes on Dr. Koch's Water Test." Mr. J. W. Westmorland, A.R.S.M.—"The Estimation and Valuation of Copper Ores and Products for Commercial Purposes."

March 1.—Mr. Boverton Redwood, F.I.C.—"Viscosimetry." Mr. T. B. Lightfoot, M.I.C.E., M.I.M.E.—"Ice Making and Cooling Machinery."

April 5.—Professor Unwin, M.I.C.E.—"The Principles and Methods of Testing Cementing Materials."

May 3.—Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy—"Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, December 7, 1885.

PROF. ARMSTRONG IN THE CHAIR.

NEW ASPECTS OF FILTRATION AND OTHER METHODS OF WATER TREATMENT; THE GELATINE PROCESS OF WATER EXAMINATION.

BY PERCY F. FRANKLAND, PH.D., B.SC., F.C.S., F.I.C.,

Associate of the Royal School of Mines.

UNTIL recently our definite knowledge of the value of filtration and other methods of water purification has been almost exclusively limited to an acquaintance with the chemical improvement which these processes are capable of effecting. This knowledge, although of the greatest importance in judging of their value, only constitutes a part, and not the whole of the information which it is desirable to acquire with regard to these processes. For, since the communication of some diseases by means of living organisms has ceased to be a theory, but has become a well-established fact, resting upon the surest foundation, it has been felt that the question of water treatment must be considered from a biological as well as from a chemical point of view. This necessity has for a long time been felt by no one more strongly than by chemists, who have devoted much attention to water and its purification, and it has been only in consequence of the want of reliable means by which the investigation could be prosecuted from this point of view that but little progress has been made in this study. It is true that methods have from time to time been devised for the biological examination of waters, but these have been so unreliable that they have failed to satisfy the exact quantitative requirements of the chemist. These methods having been generally invented by chemists themselves, they have not sufficiently taken into consideration the habits and necessities of life of those organised forms which they were intended to discover. In illustration of this I need only remind you of the ingenious method of examining waters devised more than ten years ago by Mr. Heisch. For the purpose of determining the presence of organised matter in water, Mr. Heisch added to a given quantity of the water under examination, a certain proportion of sugar, and observing that a marked difference was exhibited by waters of various origin in the production of vegetable growths subsequent to this addition, he argued that those waters which yielded an abundance of such growths were richer in organic life than those which yielded less. Mr. Heisch, however, did not bear in mind that sugar and water are not in themselves sufficient for the maintenance of plant life, but that other substances, and notably phosphates, are requisite, so that the greater or less abundance of growths in his experiments was due not to the presence or absence of living matters in the original water, but to the presence or absence of these accessory food-substances amongst the mineral constituents of the water. In point of fact, Mr. Heisch's process was found to constitute an admirable test for phosphoric acid, whilst as a means of ascertaining the biological character of waters, it was wholly unreliable. Other methods, based upon similar conceptions, but also tainted with the same fundamental error, have made their appearance since, although, as far as I am aware, they are not in actual, or at any rate extensive, use by persons engaged in water examination.

I have the honour of bringing before the Society this evening a method of examining waters biologically, upon the study of which I have been engaged for some years past, and the authorship of which is due to Dr. Koch of Berlin. This method is an adaptation, for the purposes of water examination, of a more general mode of biological investigation which has been long practised by Dr. Koch—viz., the cultivation of lower forms of life in a solid medium. The great advantage which the use of a solid medium affords, is that the micro-organisms imported into this medium grow and multiply on the spot where they have been first planted, being restricted from undergoing any movement of translation, such as necessarily takes place in a fluid. In consequence of this restriction, the progeny of each organism gathers round the parental home and forms a colony, which, rapidly increasing in size, soon becomes visible to the naked eye, the appearance of the colony being in many cases distinctive of the particular organisms of which it is composed.

It is necessary, of course, that this solid medium, into which the organisms under examination are imported, should furnish all the materials necessary for their growth and development. The medium recommended by Dr. Koch for this purpose, has the following composition:—

Lean Meat	1lb.
Gelatine	100grms.
Peptone (solid)	10 ,,
Common Salt	1 ,,
Distilled Water	1 litre.

This is also the composition of the solid nutritive medium used by me in my earlier experiments, but during the summer months I found that it became liquid at an inconveniently low temperature (about 20° C.), so that I raised the proportion of gelatine to 150grms. per litre, to which proportion I still adhere The mixture is prepared as follows :—

The meat is finely minced and infused with ½ litre of cold distilled water, for one to two hours, the solid part being then strained off through linen. The gelatine is allowed to soak in the other ½ litre of water, and to this the extract of meat is added. The whole is now heated until the complete solution of the gelatine has taken place, the peptone and salt being then added and allowed to dissolve. This liquid exhibits a distinctly acid reaction, which must be carefully neutralised by means of carbonate of soda. The neutralised liquid is then clarified by beating into it the contents of two or three eggs, along with the broken shells, the whole being briskly boiled for a few minutes. The coagulated albumen rises to the surface, and carries with it the other solid particles suspended in the liquid. On then straining through linen, a fairly clear liquid is obtained, which is finally clarified by passing through filter-paper placed in a funnel provided with a hot-water jacket, the filtrate being rejected until it runs perfectly clear and limpid. The filtrate sets, on cooling, to a yellowish-brown transparent jelly. Whilst still liquid it is poured into clean test-tubes, the quantity which I employ in each tube being exactly 7cc. The test-tubes are tightly plugged with cotton wool, and then at once sterilised by steaming them for half-an-hour, on three consecutive days, in a vessel made expressly for the purpose, and the construction of which is shown in the accompanying figure.

Tubes prepared and sterilised in this manner, I have found to remain unchanged for an indefinite period of time.

Collection of Samples of Water.

The water for examination is collected either in flasks plugged with cotton wool, or in accurately stoppered bottles ; but in either case these vessels and their stoppers must be carefully sterilised by heating in an air-bath to 150—180° C., for at least three hours. If cotton-wool stoppers are used, care must be taken that the collected water does not come in contact with the wool, and as this is unavoidable when the samples have to be conveyed any distance, I prefer collecting them in glass-stoppered bottles, of about 70cc. capacity ; these are carefully cleaned and rinsed with distilled water ; they are then dried, and the stoppers firmly screwed in, and each bottle is put into a small tin canister, which I have had made for the purpose. These canisters, with their contained bottles, are then packed into an air-bath, which is heated to 150—180° C., for at least three hours. The bottles thus sterilised can be easily transported without suffering contamination by dust to the place where the sample is to be collected. In the actual collection of the sample much care and judgment has to be used, so as to avoid the introduction of accidental sources of contamination. The outside of the bottle should be rinsed in the water before removing the stopper, and when the bottle is opened the water is at once allowed to enter, and fill the bottle to the extent of four-fifths, the stopper

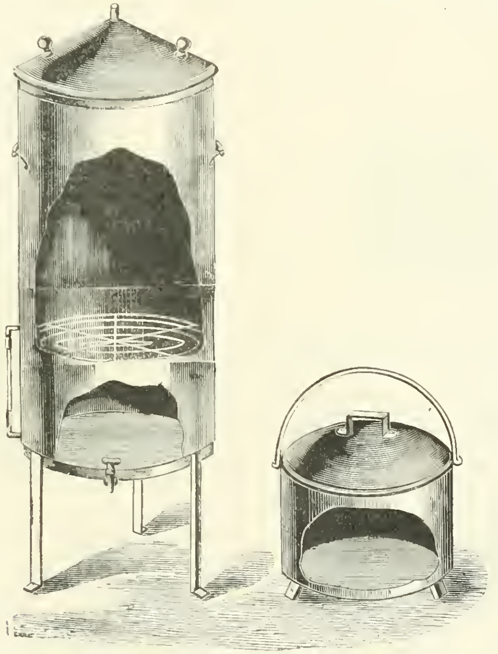


Fig. 1.—Steam Steriliser.

being immediately replaced and tightly screwed in, so that the exposure to the air is reduced to a minimum. The bottle is replaced in the tin canister, and the lid closed. In collecting samples of water from rivers, reservoirs, lakes or ponds, I do not, if possible, remove the stopper until the bottle is completely immersed in the water, and replace it while still beneath the surface.

The sample thus collected should be submitted to examination, without delay, on the same day, it possible; and during any unavoidable interval it should be kept cool.

Examination of the Sample.

Immediately before examination the sample must be violently shaken to ensure an even distribution of the organisms throughout the water, and for this purpose stoppered bottles present a great advantage over plugged flasks. The stopper is now carefully removed, and a sterilised pipette * introduced into the water. At the same time, a tube of the sterilised gelatine-peptone medium, which I melt by placing

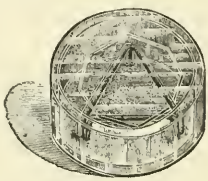


Fig. 2.

the tube in a water-bath not heated above 30° C., is opened after first burning the external portion of the cotton-wool plug in a Bunsen flame. Into the open tube a definite number of drops † of water are delivered from the pipette, the water and gelatine are rapidly mixed by agitation in the tube, which is held in a slanting position to prevent the entrance of dust. The fluid mixture of gelatine and water is then at

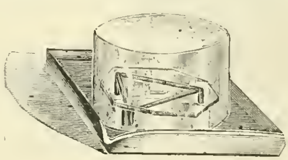


Fig. 3.

once poured on to a clean sterilised photographic plate, resting in a perfectly horizontal position, and this is then immediately covered by a glass shade. The arrangement of the shade and plate are shown in the accompanying figures (2, 3, and 4), which also illustrate the gradual process of evolution which this important part of the apparatus has undergone in the course of my experiments.

Originally two flat glass dishes fitting into each other were employed, and in the under one (the smaller of the two) a glass tripod supporting a glass plate was placed, as well as a little mercuric chloride solution (2 per cent. strength) at the bottom to maintain a moist atmosphere in the interior. The interior of the dishes was thus in direct communication, by a circuitous path it is true, with the outer air. To obviate this, I soon placed the dishes in a shallow porcelain tray, such as is used in photography, and into this tray a 2 per cent. solution of mercuric chloride was poured so as to form an antiseptic seal between the outer and inner air. More recently still, I have done away with the under dish altogether, and the tripod now simply stands in a common soup-plate, into which the solution of mercuric chloride is poured until the communication between the internal and external air is cut off, the mercuric chloride solution thus serving the double purpose of an antiseptic seal, and of maintaining the moisture of the internal air. By thus simplifying the apparatus, I have reduced the cost from about fifteen shillings to fifteen pence, a difference which is of no little consequence, as in

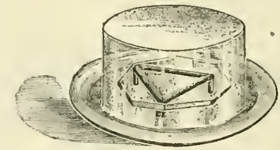


Fig. 4.

carrying out an extensive series of experiments it is necessary to have from two to three dozen of these dishes at one's disposal; whilst by the introduction of the antiseptic seal, the plates may be allowed to stand for an indefinite period of time without the possibility of aërial contamination. The sterilisation of these dishes, tripods, etc., is effected by rinsing them with the 2 per cent. solution of mercuric chloride immediately before use. They are then placed on a 3-screw levelling stand, and the glass plate resting on the tripod is rendered perfectly horizontal by means of a spirit-level. The sterilised glass plate, which is to receive the gelatine, is now carefully withdrawn

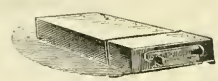


Fig. 5.

from the metal box (Fig 5), in which it has been sterilised, the future upper surface being held downwards during the transfer. As soon as it is placed on the levelled plate, the glass dish is put over it only to be momentarily again raised when the mixture of gelatine and water is poured on to the plate as already described. These operations are carried on in a room, the temperature of which is kept as low as possible, so as to accelerate the setting of the gelatine, which generally takes place in the course of a few minutes. It is also essential that in this room all sources of dust be rigorously excluded, and the table on which I operate has a glass top, and this is washed with mercuric chloride solution immediately before use.

As soon as the gelatine has set on the plate, it is at once removed in its dish from the levelling table and placed in a chamber maintained at a temperature of 20—25° C. for incubation.

The period of incubation generally varies from 3 to 5 days, but sometimes it is continued for a longer period of time to make sure that all the organisms present have had a due opportunity of development.

The gelatine plates are daily inspected during the period of incubation, without removing the glass cover, so that the progress of the colonies derived from the individual organisms may be watched;

* The pipettes are sterilised in a tin box by heating to 150—180° C. for at least three hours.

† The volume of the drops delivered by each pipette is carefully determined by previous experiment.

when these have reached such dimensions that they are distinctly visible to the naked eye, and before the contours of different colonies have begun to coalesce, the plates are withdrawn for examination. For this purpose the plate is placed upon a second glass plate of about the same size, the latter being ruled in squares and placed upon a black ground. The colonies are counted with the aid of a strong hand-lens, the more doubtful ones being further examined by means of a simple microscope. In order to arrive at an accurate conclusion with respect to the number of colonies, it is necessary that they should be all counted individually, but in cases in which the colonies are too numerous for this, an estimate of the total number may be formed by counting those present in a few of the squares, and then multiplying accordingly; this method should, however, only be resorted to in cases of absolute necessity, as the result obtained is very much less trustworthy.

If the precautions here described are rigidly, and above all intelligently, observed, little or no aërial contamination can take place in a reasonably pure atmosphere. Thus I have made a large number of experiments using boiled distilled water, and have found that almost invariably the plates remain absolutely unchanged, whilst only in most exceptional cases does any colony whatsoever make its appearance on the plate. Thus of twelve plates put up with sterilised water a week ago, no colonies made their appearance, excepting a mould on one plate. In this respect my results compare favourably with those of Dr. Koch, who finds that three colonies is the average obtained with sterilised water; now this difference may be partly due to my experiments being performed in an atmosphere which is essentially inimical to organic life—viz., that of a chemical laboratory,—whilst it is also doubtless due to the use of my mercuric chloride seal, as well as to the greater general purity of the atmosphere in English buildings. This point has long since been illustrated in connection with surgery, for Sir Joseph Lister's antiseptic treatment of wounds was eagerly adopted on the Continent, whilst it found for some time but scant favour in this country, this being due to the comparatively excellent results which had been already obtained by English surgeons, whilst on the Continent the major operations of surgery were previously attended with an excessive percentage mortality in consequence of the greater abundance of septic organisms.

Practical Application of Gelatine Process.

It is obvious that the process of water-examination just described enables us to investigate the subject of water-purification from an entirely novel point of view. By determining the number of micro-organisms present in water before and after any process of purification, we are able to obtain for the first time complete and reliable information as to the value of such a process in removing micro-organisms. Such information is, of course, of immense importance in the case of the purification of waters which are liable to dangerous contamination by organised poisons, and constitutes an invaluable supplement to the results of chemical examination.

With the aid of this process I have carried out a large number of experiments on the efficiency of various methods of water-treatment in removing living matter. The processes which I have submitted to examination may be divided into three classes :—

1. Purification by Filtration.
2. ,, ,, Agitation with Solid Particles.
3. ,, ,, Chemical Precipitation.
4. ,, ,, Natural Agencies.

I.—*PURIFICATION BY FILTRATION.*

Although it has been long known that some filtering materials, when judiciously applied, are capable of depriving water of all the organisms that it may contain; yet, until the method of gelatine culture was adopted, there was no readily available means by which the relative efficiency of different filtering materials could be estimated on a quantitative basis.

I have submitted to examination, as regards their efficiency in this respect, a number of filtering materials, employing in nearly all cases equal thicknesses of the various substances which were prepared in the same state of division. The filtering stratum was constructed exactly 6 inches in depth, and the filtering material was, with a few exceptions, made to pass through a sieve of 40 meshes to the linear inch. The results obtained in these experiments, the earlier of which were communicated to the Royal Society in June last, may be briefly stated as follows:

Ferruginous Greensand (from Redhill, Surrey).

Initial efficiency :—

Unfiltered water.................. 80 organisms per cc.
Filtered do. .... 0 ,, ,,
Reduction = 100 per cent.

Efficiency after 13 days' action :—

Unfiltered water................ 8000 organisms per cc.
Filtered do. .... 1000 ,, ,,
Reduction = 88 per cent.
Rate = ·55 litre per 24 hours.

Efficiency after 1 month's action :—

Unfiltered water................ 1280 organisms per cc.
Filtered do. .... 780 ,, ,,
Reduction = 39 per cent.
Rate = ·86 litre per 24 hours.

Animal Charcoal.

Initial efficiency :—

Unfiltered water .. Organisms too numerous to count.
Filtered do. .... 0 organisms per cc.
Reduction = 100 per cent.

Efficiency after 12 days' action :—

Unfiltered water................ 2800 organisms per cc.
Filtered do. .... 0 ,, ,,
Reduction = 100 per cent.
Rate = ·35 litre per 24 hours.

Efficiency after 1 month's action :—

Unfiltered water................ 1280 organisms per cc.
Filtered do. .... 7000 ,, ,,
Increase = 447 per cent.
Rate = ·65 litre per 24 hours.

Iron—Sponge.

Initial efficiency :—

Unfiltered water.................. 80 organisms per cc.
Filtered do. .... 0 ,, ,,
Reduction = 100 per cent.

Efficiency after 12 days' action :—

Unfiltered water................ 2800 organisms per cc.
Filtered do. .... 0 ,, ,,
Reduction = 100 per cent.
Rate = ·30 litre per 24 hours.

Efficiency after 1 month's action :—

Unfiltered water................ 1280 organisms per cc.
Filtered do .... 2 ,, ,,
Reduction = 99·8 per cent.
Rate = ·34 litre per 24 hours.

Brickdust. (Pulverised Red Brick).

Initial efficiency :—

Unfiltered water.......... ..... 3000 organisms per cc.
Filtered do. .... 730 ,, ,,
Reduction = 76 per cent.

Efficiency after 5 weeks' action :—

Unfiltered water................ 6000 organisms per cc.
Filtered do. .... 400 ,, ,,
Reduction = 93 per cent.
Rate = ·36 litre per 24 hours.

COKE.

Initial efficiency:—

Unfiltered water.................. 3000 organisms per cc.
Filtered do. .... 0 " "
Reduction = 100 per cent.

Efficiency after 5 weeks' action:—

Unfiltered water.................. 6000 organisms per cc.
Filtered do. .... 90 " "
Reduction = 98·5 per cent.
Rate = ·38 litre per 24 hours.

I have made further experiments in conjunction with my assistant, Mr. A. W. Bishop, on the efficiency of this filtering material. In these experiments the filters employed were of similar construction to those already described, but an aqueous extract of garden soil was employed instead of urine-water. Two filters (a) and (b) were submitted to examination, under conditions as similar as possible:—

Initial efficiency (2nd day):—

	Unfiltered Water.	Filter (a)	Filter (b)
Organisms in 1cc.	26,000	none	none
Reduction		100%	100%
Rate of filtration (in litres per 24 hours)		0·67	0·51

After 3 weeks' action (21st day):—

	Unfiltered Water.	Filter (a)	Filter (b)
Organisms in 1cc.	2,230	339	219
Reduction		85%	90%
Rate of filtration (in litres per 24 hours)		1·00	0·78

On comparing these latter experiments with those previously obtained, it will be seen that although the initial efficiency was in both cases the same, the greater *rate* of filtration which prevailed in the latter experiments caused the efficiency to deteriorate more rapidly, the filter (a), which was the most rapid breaking down to a greater extent than the less rapid filter (b).

The unfiltered and filtered waters respectively were also submitted to chemical examination, at the time that the filters were exerting their greatest efficiency in the removal of micro-organisms; the results are given in the following table, together with those obtained by the filtration of the same water through fine vegetable charcoal, and through a mixture of fine and coarse vegetable charcoal respectively:—

porous vegetable or wood charcoal. This material was also passed through the same sieve and employed in filters of similar construction. In the first experiment urine-water was used, with the following results:—

Initial efficiency (2nd day):—

Unfiltered water .... 9700 organisms per cc.
Water filtered through fine charcoal .. 0 " "
Reduction = 100 per cent.

Later experiments were made with an aqueous extract of soil, the following results being obtained:—

Initial efficiency (2nd day):—

Unfiltered water .... 2898 organisms per cc.
After filtration through fine wood charcoal .... 0 " "
Reduction = 100 per cent.
Rate of filtration .... 0·17 litre per 24 hours.

After one month's action (29th day):—

Unfiltered water .... 2230 organisms per cc.
After filtration through wood charcoal 107 " "
Reduction = 95 per cent.
Rate of filtration .... 0·17 litre per 24 hours.

It is thus seen that the efficiency of the fine charcoal at the end of one month is less than that of the coke with the slow rate of filtration, but greater than that of the more rapid coke filters at the end of three weeks, the rate of filtration in the case of the charcoal being markedly less than in any of the coke experiments.

In order to obtain a more rapid charcoal filter, an intimate mixture was made of equal parts of coarse and fine charcoal (the former having passed through a sieve 9 × 30 meshes, and the latter through one 40 meshes to the linear inch), and this introduced into a glass tube, so as to form a stratum of filtering material 6 inches in depth. With this filter the following results were obtained:—

Initial efficiency (2nd day):—

Unfiltered water .... 26,000 organisms per cc.
Filtered through coarse and fine charcoal.......................... 0 " "
Reduction = 100 per cent.
Rate of filtration .... 0·20 litre per 24 hours.

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

	Unfiltered Water.	Water from fine Coke. (a)	Water from fine Coke. (b)	Water from Fine Wood Charcoal.	Water from Fine and Coarse Wood Charcoal.
Total Solids	21·80	21·60	25·00	24·68	24·61
Organic Carbon	·144	·118	·107	·090	·098
" Nitrogen	·050	·040	·038	·024	·031
Ammonia	0	0	0	0	0
Nitrogen as Nitrates and Nitrites	·190	·209	·202	·221	·217
Total combined Nitrogen	·240	·219	·210	·245	·248
Chlorine	1·9	1·9	1·9	1·9	1·9
Hardness. Temporary	11·3	11·3	11·3	12·5	12·3
Hardness. Permanent	5·6	5·6	5·6	1·6	4·6
Hardness. Total	16·9	16·9	16·9	17·1	16·9

These results show that filtration through coke exerts but an insignificant chemical action, even when the purification from a biological point of view is complete.

VEGETABLE CHARCOAL.

The very favourable results obtained with coke led me to investigate the filtering power of the still more

After three weeks' action (21st day):—

Unfiltered water .... 2230 organisms per cc.
Filtered through coarse and fine charcoal 506 " "
Reduction = 77 per cent.
Rate of filtration .... 0·45 litre per 24 hours

Thus with wood charcoal, when the rate of filtration approaches that through coke, the improvement, from a biological point of view, is markedly less.

The effect which this material has upon the chemical composition of the water, as exhibited in the above table, is greater than that of coke, but also not very considerable.

It has generally been supposed that most filtering materials offer little or no barrier to micro-organisms, and that the latter are capable of passing without sensible obstruction through the pores of filters containing pulverised materials. These experiments, however, show that it is extremely simple to construct filters which shall possess the power of removing micro-organisms, in the first instance at least. This power is, moreover, possessed by substances which exercise scarcely any chemical action on the organic matter present in the water—*e.g.*, coke, vegetable charcoal, and biscuit porcelain, as well as by those which reduce both the organic and mineral ingredients of the water to a very marked extent, like animal charcoal and iron.

Especially noticeable is the case of vegetable carbon, whether in the form of charcoal or coke; this material has been generally regarded as of but little value for water purification, owing to its chemical inactivity; but as biological filters, we see that these substances occupy a very high place, and, owing to their cheapness and the facility with which they may be renewed and profitably disposed of as fuel, they are in my opinion destined to be of great service in the purification of water. These materials, coke and vegetable charcoal, are also specially well fitted for use in breweries and distilleries, where it is so necessary to have a water which, though perfectly free from organic life, is at the same time free from antiseptic substances, such as iron, which militate against fermentation. Coke has already been used in this capacity, at my suggestion, with marked success.

My experiments, however, show most distinctly the necessity of frequent renewal even in the case of the best filtering materials, and this is a point which, unfortunately, is too often lost sight of—the idea that "once a filter always a filter," being erroneous in the extreme.

Lastly, we have abundant confirmation of the principle which has long been known to water engineers—viz., that what is gained in rapidity is lost in efficiency, and *vice versâ*.

II.—*PURIFICATION BY AGITATION WITH SOLID PARTICLES.*

It appeared probable, from the results of the filtration experiments already described, that organised matter might be largely removed by mere contact with finely divided matter. A series of experiments was consequently undertaken with a view to ascertaining to what extent this was the case, and in some instances the reduction was found to be very much greater than could have reasonably been anticipated.

In these experiments water containing micro-organisms was shaken up for a definite length of time with a given quantity of the finely divided matter, which was used in the same state of subdivision as in the filters already described. The water was then allowed to subside and the clarified water submitted to examination *as soon as possible* after complete subsidence had taken place, as I argued that, if the organisms were simply carried to the bottom by the subsiding particles without suffering any injury, they would rapidly again become distriduted through the upper layers of water by multiplication. This supposition has been amply verified by experiment.

AGITATION WITH SPONGY IRON.

The water was shaken with one-tenth of its weight of this material for one minute in one case, and for fifteen minutes in another. In each case the water was allowed to subside for half-an-hour before examination.

Untreated water contained .... 609 organisms per cc.
After 1 minute's agitation ...... 28 ,, ,,
Reduction = 95 per cent.
After 15 minutes' agitation .... 63 organisms per cc.
Reduction = 90 per cent.

On another occasion the water of the Thames at Hampton was shaken with spongy iron for fifteen minutes with the following result:—

Thames water.................... 155 organisms per cc.
,, after 15 minutes' agitation 10 ,, ,,
Reduction = 93 per cent.

AGITATION WITH CHALK.

Urine-water was shaken for fifteen minutes with one-fiftieth of its weight of chalk, and then allowed to subside for five hours:—

Untreated water................ 8000 organisms per cc.
Ditto after agitation .... 270 ,, ,,
Reduction = 97 per cent.

AGITATION WITH ANIMAL CHARCOAL.

Urine-water was shaken with one-fiftieth of its weight of animal charcoal for fifteen minutes, and then allowed to subside for nearly five hours:—

Untreated water................ 8000 organisms per cc.
Ditto after agitation .... 60 ,, ,,
Reduction = 99 per cent.

AGITATION WITH VEGETABLE CHARCOAL.

Water containing soil-extract was shaken with one-fiftieth of its weight of ordinary wood charcoal for fifteen minutes, and was then allowed to subside for twenty-seven hours:—

Untreated water................ 3000 organisms per cc.
Ditto after agitation .... 120 ,, ,,
Reduction = 96 per cent.

AGITATION WITH COKE.

Urine-water was shaken with one-fiftieth of its weight of fine coke for fifteen minutes, and then allowed to subside for forty-eight hours:—

Untreated water.......... Too numerous to be counted.
After agitation with coke None.
Reduction = 100 per cent.

Further experiments made with water containing soil-extract have shown that this process of purification is unreliable, owing apparently to the numerous conditions which are necessary for its success. I have found that in some cases the number of organisms in the clear liquid is greatly increased, this being doubtless due to a reascension and multiplication of those which were at first carried down. Thus, in one series of experiments I obtained the following results:—

Untreated water............. 3000 organisms per cc.
After agitation with coke and
26 hours' subsidence .... 20,000 ,, ,,

Further experiments of a similar nature were made, but less time (only five hours) were allowed for subsidence:—

Untreated water .... 655 organisms per cc.
After agitation with coke and
5 hours' subsidence .... 28 ,, ,,
Reduction = 96 per cent.

Thus, although a most remarkable purification may be accomplished by this simple process of agitation with the various substances specified, yet owing to the uncertainty of its success its efficiency cannot at present be relied upon.

Water was also agitated with several other substances such as china clay, brickdust, plaster of

Paris, oxide of manganese, etc.; all of these, however, yielded unsatisfactory results.

The removal of micro-organisms through the surface-attraction of suspended particles naturally leads us to a consideration of what takes place when the suspended particles are generated in the water itself by way of precipitation.

III.—*PURIFICATION OF WATER BY PRECIPITATION.*

As by far the commonest and most important method of water purification dependent upon precipitation is the well-known Clark's Process, the effect of this on organised matters was made the subject of special study. With this view I have examined the process both in the laboratory as well as on the large scale, as practised by manufacturers and water companies.

LABORATORY EXPERIMENTS.

For testing the efficiency of the process on the laboratory scale, three stoppered Winchester quart bottles were taken, and to each were added two litres of ordinary London (Thames) water, to which a convenient proportion of organisms had been imparted by the addition of urine-water. To two of these bottles 100cc. of clear lime water were added, this being calculated to remove 11·6 parts of carbonate of lime per 100,000 parts of the water. Each of these bottles was violently shaken, and then allowed to subside for eighteen hours. The third bottle, to which no lime water had been added, was first tested for the number of organisms contained in the experimental water. After eighteen hours the two bottles to which lime water had been added were tested without disturbing the precipitate, as was also the third bottle, which had been left at rest in the same place as the other two. These tests showed the following numbers of organisms to be present in the water before and after treatment:—

Untreated water	85	organisms per cc.
,, after 18 hours' rest	1922	,, ,,
Water after Clark's Process and 18 hours' subsidence	42	,, ,,

Reduction on original = 51 per cent.

In order to appreciate the real value of the treatment by Clark's process, it is necessary that the treated waters should be compared not only with the original water, but also with the untreated water after eighteen hours' rest, for the latter obviously indicates what the condition of the water would have been at the time of examination if no lime water had been added. It appeared to me probable that, after the subsidence of the carbonate of lime precipitate had taken place, the organisms which had been carried down by the latter would again become distributed throughout the upper layers of the water, and in order to ascertain whether this was the case or not, the same waters which had remained stoppered up and at rest were again examined after the lapse of ten days. It was then found that the untreated, as well as the softened waters, contained immense numbers of organisms in their upper layers.

In another series of experiments carried out under the same conditions, excepting that twenty-one instead of eighteen hours were allowed for the subsidence of the carbonate of lime, I obtained a reduction in the number of organisms amounting to forty-one per cent.

EXPERIMENTS ON INDUSTRIAL SCALE.

It appeared to me to be of great interest to ascertain what results can be obtained by Clark's process on the large scale. For this purpose the process of softening, as practised at the Colne Valley Waterworks at Bushey, near Watford, was investigated, as well as the new modification of Clark's process devised by Messrs. Gaillet and Huet, which is now in operation at Mr. Duncan's Sugar Refinery, Clyde Wharf, Victoria Dock. I am indebted to Mr. Verini, of the Colne Valley Waterworks, as well as to Mr. Duncan and Mr. Newlands, for their kindness in permitting me to carry out these experiments.

At the Colne Valley Waterworks, the hard water, obtained from a deep well sunk into the chalk, is mixed with the requisite proportion of clear lime water, and then allowed to settle in open tanks. The susidence is so rapid that under favourable circumstances the upper layers of water are, after three hours' time, fit for distribution. On the occasion of my visit, however, boring operations were being carried on, and the water was, in consequence, milky, and the necessary subsidence after softening had to be increased to two days. I was unfortunately unable to obtain a perfectly representative sample of the water before softening, and the number of organisms found in the untreated water is probably in excess of that which was present in the unsoftened water actually employed. The following results were obtained:—

Unsoftened water	322	organisms per cc.
Water after softening and 2 days' subsidence (from main)	4	,, ,,

Reduction = 99 per cent.

In Gaillet and Huet's process, as carried out at Mr. Duncan's, the water from an artesian well sunk into the chalk below the London clay, is mixed with a suitable proportion of lime water and caustic soda, the mixture being then made to pass upwards through a tower provided with oblique diaphragms, which accelerate the precipitation of the carbonate of lime. The passage through this tower occupies a period of about two hours. Samples of the water, before and after treatment, were examined with the following results:—

Well water from tanks	182	organisms per cc.
Softened water	4	,, ,,

Reduction = 98 per cent.

These results, and especially those obtained on the industrial scale, conclusively prove that Clark's process is a most valuable agent for purifying water biologically, and the value of the process, from a chemical point of view, is illustrated by the following analyses:—

	Parts per 100,000. Total Solids.	Org. C.	Org. N.	Hardness.
Caterham Water Supply before softening	27·68	·028	·009	21·2
Ditto after softening by Clark's Process	8·80	·015	·003	4·4

GAILLET AND HUET'S PROCESS.

	Well at Clyde Wharf, Victoria Dock.	Ditto after softening.
Total Solids	58·76	11·20
Organic Carbon	·111	·084
,, Nitrogen	·017	·016
Ammonia	·050	·060
N as nitrates and nitrites	0	0
Chlorine	16·7	17·3
Hardness Temporary	19·8	2·4
Hardness Permanent	8·0	6·0
Hardness Total	27·8	8·1
SO_3	3·96	1·01
SiO_2	1·44	·69
Al_2O_3 and Fe_2O_3	·22	·11
CaO	12·57	5·96
MgO	2·82	·57
K_2O	·93	1·06
Na_2O	13·13	15·76
Na_2CO_3	0	2·0
$CaCO_3$	21·32	5·39
$MgCO_3$	1·13	1·20
Suspended Matter.		
Mineral	·22	—
Organic	·10	turbid.
Total	·32	—

On comparing the reduction of the organic matter, as indicated by chemical analysis, with the diminution

in the number of micro-organisms revealed by the biological examination, it will be seen that the biological efficiency of Clark's process is markedly superior to its power as a chemical purifier. This is obviously a matter of great importance, as it shows the value of methods of precipitation in removing micro-organisms; it must, however, be borne in mind that the particular precipitation-process which I have studied, is carried out with the greatest care and cleanliness, and it would obviously be highly out of place to compare with this many of the slovenly and farcical performances which enjoy the title of "Sewage Precipitation." It is a rule to which there is no exception, that satisfactory results, as regards the removal of micro-organisms, can only be obtained when the most scrupulous care and continuous attention are given to the matter, and failure will inevitably result when such processes are entrusted to ignorant and inexperienced persons.

IV.—*PURIFICATION BY NATURAL AGENCIES.*

It is a matter of common knowledge that of natural waters the purest, as regards organic matter, are those which have undergone prolonged filtration through porous strata. Such waters obtained from deep wells and deep-seated springs often contain the merest trace of organic matter, which is only discoverable and capable of being quantitatively determined by the most refined analytical methods. It has also been shown by Pasteur that many of these waters are entirely destitute of organic life, or in other words *sterile*. Of a number of waters of this kind, I have only met with one sample that was absolutely free from organic life, although some have closely approached this ideal state of things. It must, however, be remembered that the collection of natural waters of this kind, in a sterile condition, is fraught with great difficulty, inasmuch as the places where such waters issue are almost invariably surrounded by conditions which favour the communication of organised matters to the water. Thus the damp earthy surfaces, with which the issuing water comes in contact, form a favourable seat for the development of many growths. This difficulty is nowhere more apparent than at the Deptford well of the Kent Co., from the mouth of which several millions of gallons of water are daily disgorged. No more suitable place could, at first sight, be imagined; but a closer inspection shows that the pump rods and other surfaces with which the water is brought in contact, are coated with green vegetable life, and my monthly examinations of this water show that each cubic centimetre contains its complement, a small one only it is true, of organic life capable of growth and multiplication in the gelatine peptone medium. Thus the water collected direct from the Kent Co.'s well at Deptford contained:—

June 4th, 1885....	(temp. 12·4 C.) ..	6 organisms per cc.
Oct. 29th, ,, ...	(,, 12·0) ..	6 ,, ,,
Nov. 25th, ,, ...	(,, 11·7) ..	8 ,, ,,

Again, the water from a spring, the Upper Greensand, near Reigate, contained:—

June 5th, 1885 .... 8 organisms per cc.

In the application of the gelatine process to the examination of potable water, I wish to point out that our opinion as to the biological purity of the water should be based, not only upon the aggregate number of organisms found, but also upon the number of different varieties which the cultivation reveals. A water containing only one or two varieties is, *cæteris paribus*, to be preferred to one in which there are many varieties, as in the latter case it is evident that the water has been subject to numerous sources of contamination, and that it has not been exposed to influences inimical to the life of a number of different classes of micro-organisms. In my experiments on the artificial purification of water, I have always found that it is more difficult to remove some classes of organisms than others. Thus, those which cause liquefaction of the gelatine appear to offer least difficulty in their removal. I could quote numerous instances of this, but the following case illustrates this point in a most striking manner. In the experiments on filtration through vegetable charcoal, we have already seen that the

Unfiltered water contained ... 2230 organisms per cc.
Filtered ,, ,, ... 506 ,, ,,
Reduction = 77 per cent.

If, however, we only take into consideration the organisms causing liquefaction of gelatine, we find

Unfiltered water contained.. 785 organisms (liq.) per cc.
Filtered ,, ,, .. 1 ,,
Reduction = 99·87 per cent.

GELATINE PROCESS APPLIED TO LONDON WATERS.

For more than a year past I have made periodical examinations by this process of all the waters supplied to the Metropolis, and the first results which I obtained were made known in a lecture which I delivered in February last, at the Parker's Museum of Hygiene and subsequently at the Royal Society. At the request of Col. Sir Francis Bolton, I now furnish these results (see page 706) regularly to the Local Government Board, and they are published in his, the Official Water Examiner's monthly reports.

The results of these examinations are of peculiar interest when they are studied side by side with the results of similar examinations made of the river waters from which the Metropolitan supply is mainly derived. It is, of course, impossible to obtain perfectly representative samples of the water before and after treatment by the companies, but the plan which, after reflection, I have adopted, and which appears to me to be the only practicable one, is to collect samples of the river-water as it passes the companies' intakes on the same day as that on which the samples of the water actually supplied to the consumer are taken. In this manner the samples, taken over a considerable period of time, will be representative of the average quality of the river-water on the one hand, and of the actual supply on the other. A mere glance at the results of these observations, which are embodied in the annexed table, will distinctly show the striking improvement, as regards removal of organic life, which the river-waters undergo in passing through the companies' works. Taking the average of three such observations, it will be seen that the micro-organisms in the river Thames have been reduced to the extent of 86 per cent. before reaching the consumer.

It is obvious that by this method of examination a most valuable check can be kept upon the working of the filter-beds and other purifying plant of waterworks.

It is necessary to add some words of explanation with regard to the difference in the number of organisms found in the water of the Kent well, and in that supplied to the district of the same company. The water of the Kent Company leaves the well, as is seen, almost wholly destitute of organic life, and the few organisms which it does contain are almost certainly imported into it in passing over the surfaces at the mouth of the well already referred to. These newly imported organisms are placed in a position particularly favourable for their growth and development, the plant-food which the water contains not having been exhausted by previous generations of micro-organisms. The consequence is that this small com-

plement of organisms undergoes considerable multiplication before reaching the point in the district where the other samples are collected.

In the case of the river-water, the conditions are entirely different. During the flow of the river from its source, down to the intakes of the companies, the water has received a continual accession of organisms from various sources, and these have had undisturbed opportunity ot reproduction limited only by the temperature and the amount of food which they have found in the river; this water enters the storage reservoirs of the companies, where the food present in the water is more or less exhausted according to the length of the period of storage; the water then passes on to the filters, where by far the greater number of organisms are removed, and those which find their way through, or are accidentally introduced after filtration, find less opportunity of rapid multiplication in this more or less exhausted medium, than do the organisms imported into the virgin soil of the deep-well water. In time, however, these organisms in the filtered river-water also multiply largely, for I have found that if the water for chemical analysis contained in the ordinary sample bottles, which are used exclusively for the waters of the respective companies, be submitted to examination with gelatine, a very much larger number of organisms are invariably found. Thus: Grand Junction Co.'s water, in November, 1884, from ordinary sample-bottle which had beeu standing in the laboratory, contained upwards of 89,000 organisms in 1cc.

ber of organisms in the water was ascertained at the outset of the experiment, again at the end of 6 hours the number was determined in one of the bottles, at the end of 24 hours in the second bottle, and lastly, at the end of 48 hours, in the third bottle. The numbers found were as follows :—

Hours of Subsidence.	No. of Organisms in 1cc.
0 (morning)	1,073
6 (evening)	6,028
24 (morning)	7,262
48 (morning)	48,100

The comparatively small increase between the 6th and 24th hour is accounted for by the low temperature which must have prevailed during the night, the increase during the first 6 hours being during the daytime. In the last number of the *Chemical News*, I see that these results have been recently confirmed by Dr. T. Leone, in the case of a pure spring water at Munich, which reaches the town with five organisms in 1cc.; but on standing 24 hours, contains more than 100; in 2 days, 10,500; in three days, 67,000; in 4 days, 315,000; and on the fifth day, more than half-a-million in 1cc. The temperature at which this multiplication took place was 14—18° C.

The principal conclusions to be drawn from the experiments to which I have referred, are :—

1. That the complete removal of micro-organisms from water, by filtration, is unattainable without frequent renewal of the best filtering matters, and duly restricting the rate of filtration.

MICRO-ORGANISMS IN 1cc. OF METROPOLITAN WATERS, 1885.

	Jan.	Feb.	March.	May.	June.		Sept.	Oct.	Nov.
River Thames at Hampton	—	—	—	—	155	—	1614	711	1866
Chelsea	8	23	10	11	22	81	13	34	3
West Middlesex	2	16	7	3	—	26	2	2	5
Southwark	13	26	216	21	—	47	18	21	32
Grand Junction	382	57	28	3	21	18	43	40	10
Lambeth........................	10	5	69	30	—	38	103	26	26
RIVER LEA.									
River Lea at Chingford Mill ..	—	—	—	—		—	—	—	954
New River......................	7	7	95	3	—	27	3	2	11
East London	25	39	17	121	—	22	29	53	14
DEEP WELLS.									
Kent (well at Deptford)	—	—	—	—	6	—	—	6	8
,, (supply)	10	41	9	20	26	—	14	18	—

I have had, moreover, repeated experience in the laboratory of the fact, that if a water which is comparatively free from organisms be inoculated with a few drops of a fluid highly charged with organisms, the latter will multiply with astonishing rapidity. I have already pointed this out in the case of some of the experiments with agitation and Clark's process, detailed above, and it is still more strikingly illustrated by the following experiments, which were also published before the Royal Society. Many litres of ordinary distilled water were impregnated with a few drops of urine-water containing abundant organisms; this infected water was placed in three sterilised Winchester quart bottles, plugged with sterilised cotton-wool, and the bottles were placed in a room, the average temperature of which was about 10° C. during the daytime, and left at perfect rest. The num-

2. That a very great reduction in the amount of organised matter in water may be accomplished by filtering materials, which have hitherto been generally regarded as almost ineffectual.

3. That organised matter is, to a large and sometimes to a most remarkable extent, removable from water by agitation with suitable solids in a fine state of division, but that such methods of purification are unreliable.

4. The chemical precipitation is attended with a large reduction in the number of micro-organisms present in the water, in which the precipitate is made to form and allowed to subside.

5. That if subsidence, either after agitation or after precipitation, be continued too long, the organisms first carried down may again become redistributed throughout the water.

In introducing this method of investigation to the notice of the Society, I should point out that it is only by bestowing the most scrupulous care on every detail of the process, that reliable results can be obtained, and any carelessness must inevitably, sooner or later, be followed by failure. In connection with this I may appropriately quote the following words of Dr. Klein—"Micro-organisms and Disease": Macmillan & Co., 1885 :—

"All this may appear to some rather tedious and unnecessarily complicated, but it cannot be too strongly insisted on that in these matters one cannot be too scrupulous. A slight relaxation may, and occasionally is, followed by disastrous consequences, in the shape of accidental contamination, and consequent loss of material prepared at the cost of much labour and time. Several weeks' work may be annihilated by a single omission. Sometimes one is perhaps in a slight hurry, and does not think the want of an additional heating of the test-tube or cotton-wool, or an additional boiling of the fluid, will be followed by any bad consequences. But, alas ! Nature does not take into account our convenience, and failure is our reward. If in any experiments 'overdoing' is an error in the right direction, it is in these very experiments on the cultivation of micro-organisms."

In conclusion, I must express my thanks to my assistant, Mr. A. W. Bishop, for the invaluable aid which I have received from him, in conducting my later experiments.

DISCUSSION.

Mr. Bischof said he had taken a number of notes ; but, as he expected to have the honour of reading, in February, a paper on a subject somewhat similar to that before the meeting, he would confine himself to such points as he did not then intend to deal with. The author of the paper mentioned that he had found it necessary, on account of the summer heat, to increase the quantity of gelatine. Now, this had never happened in his own experience. He had had the privilege of studying this method in Dr. Koch's private laboratory in Berlin, and had followed his method exactly. Of course, there might be improvements ; and he himself looked forward with great pleasure to trying some of the modifications mentioned that evening. The mixing of eggs with gelatine was quite foreign to Dr. Koch's procedure. He (Mr. Bischof) understood the author to say that gelatine was filled into clean test-tubes. Did he mean by this sterilised tubes ? Dr. Koch sterilised the test-tube before the gelatine was filled in, which he considered quite essential. He sterilised the gelatine in the test-tubes themselves by exposing them in the apparatus on three consecutive days to steam for fourteen minutes each day. The procedure of burning the cotton wool, described in the paper, was not practised by Dr. Koch. The wool stopper was simply taken out with the hand, the sample introduced, and the stopper at once replaced. It was again taken out when the sample had to be spread on the glass plate, and before pouring out the gelatine the mouth of the test-tube was passed through a Bunsen flame in order to destroy any organisms which might adhere to the outside. The temperature of 20° to 25° for incubation appeared somewhat high. He found his gelatine at 25° became very soft. With regard to the filtration experiment, he thought it would have been an improvement if Dr. P. Frankland had employed the materials of such size and grain as could be practically used ; for he feared materials which had been passed through a sieve having forty meshes to the inch could not be employed practically. Filters so constructed would be too "choky ;" and, therefore, the valuable deductions made could not with perfect certainty be applied to practical working. Again, if these experiments were continued, he would ask the author to consider whether he could not carry them on with different materials simultaneously, supplying them all from a common reservoir ; as, in that case, the results could be better compared. It was not sufficient to state that one water contained so many organisms, and another so many. They might differ in kind ; and on this the result would greatly depend. He did not quite understand why the most natural unfiltered water had not been taken—viz., diluted sewage. Of course, urine would tell a great deal, for there was a considerable quantity of urine in sewage ; but why not take dilute sewage itself ? In his experiments, he had invariably used sewage filtered through paper to which 1 per cent. of river water was added. He could thoroughly confirm, from his own experience, the enormous increase which took place on standing in water, even of good biological quality.

Mr. Salamon thought it was to be regretted Dr. P. Frankland had not made special cultures of the different organisms filtering through the various materials. Had he done so, he would have found that there was a certain selective preference exercised by these materials in regard to their sterilising powers. He had made some experiments in this special direction, having been consulted with reference to a "fret," or after-fermentation, which had been manifested in certain beers during the recent summer weather. After looking thoroughly into the matter, he came to the conclusion that the water was impure for brewing purposes. Of course, he need not say the small quantity of organic matter being normal in amount, did no harm whatever for this purpose. He found, on culture of the water, that he could ascertain and identify the presence of certain specific organisms. Happening to call at South Kensington, he mentioned the matter to Dr. P. Frankland, and had the advantage of discussing it with him and Dr. Frankland, senior, when they both advised him to filter the water through coke. Acting on this suggestion, he had some large filters fitted up, the coke being in a fine state of division, and passed the water through it ; and he must say the results were most satisfactory. The fret disappeared ; and though the beer was perhaps a little flattened, the result, on the whole, was good. In fact, the utmost satisfaction was given by the treatment adopted. He communicated these results to Dr. P. Frankland, and told him also that he had discovered certain facts with regard to the chemical action on these points, upon which he saw they were not agreed. He was afterwards consulted on another question of an exactly similar nature, where he found that the organisms which caused the trouble in question were not the same. He tried a coke filter again, with exactly the same rate of filtration, and arrived at the conclusion that in this case the coke filter was absolutely useless. It did not keep back the specific germs to the same extent as in the water first treated, so that it was useless as a steriliser. In both cases he used the same kind of coke. The author, in his experiment respecting the change in chemical composition, did not make any mention of the kind of coke ; but this seemed most important. Coke varied very much in composition ; and the chemical composition of the water passing through it was considerably affected by the composition of the coke itself. The sole experiment narrated of passing water through six inches of coke in a small tube was almost insufficient for testing chemical composition. He made many hundreds of experiments in this direction ; and for this purpose took a tube 30 inches long and 3 or 4 inches in diameter, filled it with ground coke, and passed the

water through it, and he found that the effects produced on the water before and after were so pronounced as to be in all respects comparable to those obtained by filtration through spongy iron. If, however, he took the same coke, and boiled it with hydrochloric acid so as to remove certain mineral matters, he obtained negative results. This seemed to point to the existence of a couple between the iron and the coke which must necessarily vary with the composition of the coke itself; and, of course, it was possible to accentuate the action of the couple. On seeing the marvellous results obtained by these filtering materials, it was somewhat difficult to contend that it was possible for such an action to take place without some corresponding chemical action; and he believed, if Dr. P. Frankland would repeat the experiments, he would find that the chemical changes he had pointed out were in all cases correct. Another point was the chemical composition of the nutritive materials. This was stated to be neutral; but he thought if it were slightly alkaline it would be better for the growth of the organisms likely to occur in water.

Dr. Messel thought these experiments seemed to show that, whatever filtering material was used, after a time it became inoperative, and indeed seemed to introduce foreign matter into the water. Speaking of Gaillet and Huet's modification of Clark's process, where there was a portion of the precipitate which, notwithstanding it was frequently blown off, remained in the apparatus, after a certain lapse of time this exercised a contaminating effect on the water itself. He should have thought that this, while being an excellent apparatus for the purification of water from one point of view, would be the very agent for introducing as many microbes into it as possible. Of course, where sulphate of lime is present in the water, and, through the addition of soda, sulphate of soda, this may be destructive to the lower organisms; but this does not hold good of the original Clark's process, where lime is used, and which gives water equally free from microbes.

Mr. B. E. R. Newlands said in the Gaillet and Huet process, at Clyde Wharf, the use of the soda produced a gummy precipitate not to be found under the ordinary Clark's process, and he could quite understand that this would make a considerable difference in the number of micro-organisms, as they would be dragged down by the precipitate. In Clark's process, this precipitate was crystalline; but, in the other case, it was a gummy and tenacious sort of mass. With regard to what Dr. Messel had said, he might mention that the precipitate was drawn away two or three times every hour, so that there was little likelihood of any unfortunate micro-organisms having a chance to rise. Some of these micro-organisms on the screen appeared to be very much larger than others. Several were like vast continents, and others like small islands. The author pointed them out, and counted them up exactly as if they were all alike. He was not familiar with this class of work, but it appeared to him that these great colonies deserved more attention, and that it would be better to measure them, and to state that there were so many square inches in a certain amount of water instead of merely counting them.

Mr. Crowder said it would appear that there is some relation between the water and the medium through which it passed; and he should like to know if Dr. P. Frankland had made any experiments as to the quantity of water which could be sent through a certain medium. For instance, he took coke or animal charcoal; but could he give the meeting any comparative table of the quantity of water which passed through coke until it became contaminated, and the same with spongy iron and charcoal?

Mr. Cresswell asked if Dr. P. Frankland could say what characters the water developed after being agitated with the various materials, and precipitated as mentioned in the third division of his subject. Were any differences observed as to their capacity for developing organisms?

Dr. P. Frankland, in reply to Mr. Bischof, said that eggs were used by a number of bacteriologists; and although this was Dr. Koch's process, it was now the property of the scientific world, and anyone was at perfect liberty to introduce an improvement. There could be no doubt that the introduction of eggs greatly facilitated the clarification of the liquid, and many authorities, including Dr. Klein, recommended their use for this purpose. With regard to the sterilisation of the apparatus, the only point on which his procedure appeared to differ from that of Dr. Koch, was that the tubes were not sterilised before the gelatine was introduced, but they were thoroughly washed and cleaned with acid. What was the use of sterilising test-tubes into which a liquor was going to be poured which was not itself sterile? When the gelatin was filtered into them, it was not sterile at all, having been exposed for a whole day during filtration, and might contain many organisms; but as soon as it was in the test-tube it was exposed to the crucial process of sterilisation with steam for half-an-hour on three successive days. The lapse of this interval between each steaming was of the greatest importance. The burning of the cotton wool he took to be a very important point. The wool was exposed to all kinds of contamination from the atmosphere, and doubtless the surface was covered with many organisms; and it was burnt so as to get the surface completely sterile, and then gradually removed—the edge of the tube being heated in the flame in case anything should lodge there. On the whole, his process agreed extremely well with that of Dr. Koch, and, at any rate, was not open to any objection on the score of sterilisation, because he produced sterile plates when he operated with sterile water. Operating with a corrosive sublimate seal, it was obvious the process was very complete, otherwise he should not get these sterile plates. With regard to the degree of fineness of the filtering media, when he commenced these experiments he was so sceptical as to the filtering power of any medium, that he thought he would give these substances the best chance he could, and therefore used the very finest materials. He did not think it was absolutely impossible to use such materials on a large scale, for he had had some filters of considerable size constructed of coke of the fineness described. He believed it was somewhat troublesome to prepare this coke; still it was done. He entirely agreed with Mr. Bischof that it would be more satisfactory if all these filtering experiments could be carried on side by side, the supplies being drawn from a common reservoir wherever practicable; and the unfiltered water was one and the same. The same water also was used for the filtration and precipitation experiments whenever possible; and he had given all the filters the same raw materials to deal with. He quite agreed with Mr. Salamon, and had pointed out in the paper that there was undoubtedly a certain amount of selective action on the part of these various filtering substances; he had pointed out also that the liquefying organisms were apparently most easily removed. With regard to the chemical action of the coke, he would ask what the composition of Mr. Salamon's coke was, because his coke, instead of reducing nitrates like spongy iron, produced them. He understood Mr. Salamon to say that if it passed through thirty inches of coke the nitrates would be destroyed.

Mr. Salamon said there was an increase in the ammonia.

Dr. P. Frankland said the nitrogen must appear somehow, either as ammonia or as nitrates. In his experiment it appeared as nitrates, and he could not very well conceive how it was that by lengthening the filtering-tube, a different effect should be produced.

Mr. Salamon said the organic carbon would be reduced from 0·14 to 0·05. He had had results in which the nitrates had gone to nothing; but, of course, the ammonia was correspondingly increased.

Dr. P. Frankland said this must obviously be due to some difference between the cokes employed. It was quite reasonable to suppose that spongy iron should be formed in coke; there was a certain quantity of pyrites in the coal, which, at the high temperature of the gas-retort, would doubtless appear, to some extent, as spongy iron: but this did not seem to be the action of the coke of which he had made use. He did not think the waters could have undergone nitrification in the bottles, as the time was so short. With regard to the reaction of the nutritive medium, which he had described as neutral, one could only say that such an originally acid body was neutral when it was slightly alkaline. It would not do to exceed this alkalinity; and probably the neutral medium indicated the growth of the maximum number of organisms. The most satisfactory way of performing the test, although it would complicate it, would be to use three media; to put up one plate with an acid, another with a neutral, and a third with an alkaline medium. It was possible to go still further than this, and surround one with an atmosphere of air, another with an atmosphere of carbonic anhydride, and a third with an atmosphere of nitrogen. In fact, there was no limit to the degree of completeness to which this method might be carried. It must not be supposed that the number of organisms found absolutely represented the number contained in the water. There might be organisms which did not thrive in this particular medium. It was well known to bacteriologists that there were organisms which did not thrive well until a much higher temperature was obtained than could be used with this gelatine medium. Mr. Bischof said his gelatine became very soft at 25° C.; but some pathogenic organisms required a temperature of upwards of 30° to develop with any vigour. This brought him to the point mentioned by Mr. Newlands—that to gauge the activity of the organisms one should measure the size of the colonies to which they gave rise. Of course, this difference in the size of the colonies was mainly dependent on the fitness of the medium for their growth. These enormous liquefying colonies were doubtless those which flourished best, in this particular medium; but he did not think it would be a fair mode of proceeding to consider the size of a colony produced as any measure of the importance of the organism present. Of course, as bacteriology progressed, the properties of the organisms belonging to each colony would be more definitely known. With regard to the remark of Dr. Messel about the precipitated carbonate of lime in Gaillet and Huet's process acting as a source for importing organisms into water, as Mr. Newlands had pointed out, this carbonate of lime was drawn off two or three times an hour from the diaphragms; and, therefore, any accumulation of material tending to foster organisms was prevented. He had pointed out that, if the water were allowed to stand in contact with the precipitated carbonate of lime, a re-ascension of the organisms took place; and the water became just as fully charged with them as it was before the softening process. Mr. Cresswell's remarks undoubtedly indicated an interesting field of investigation—viz., a study of the relative rate in which organisms multiply in various waters. It would be interesting to try whether the organisms would multiply more rapidly in the Kent chalk waters than in the river waters, which his experience showed apparently they did. He had only examined this in a few cases; but it was obvious that it might be extended.

The Chairman said chemists had long felt that it was very difficult for them to venture on an opinion as to the value of a potable water in many cases, and they had been anxiously looking out for the introduction of some such method as that before the meeting. It must be a source of congratulation to the members that Koch's method was being taken up in this country by one who fortunately possessed the qualifications of the chemist, because it was useless for a matter of this sort to be dealt with simply by a biologist, who would look at it from a too one-sided point of view. It was essential that someone who would take pains to carry out the biological method with the necessary care, and who at the same time possessed the requisite chemical knowledge, should attack the question. The criticisms passed on the paper tended, for the most part, to show that Dr. Frankland had materially improved the method, for Mr. Bischof's complaints were rather directed against the excessive precautions taken.

NOTE ON THE DECOMPOSITION OF AMMONIUM CHLORIDE SOLUTION BY CALCIUM CARBONATE.

BY FRANK L. TEED, D.SC.

The late Dr. James Young patented in 1872 (No. 2988) the decomposition by calcium or magnesium carbonates of the ammonium chloride solution produced in the ammonia soda process. His process is to boil the solution with about $1\frac{1}{2}$ equivalents of the carbonates of lime or magnesia in a still or boiler; but he could not succeed in making the decomposition complete, so that at the end he was obliged to add about one-third of an equivalent of lime, to get off his residual ammonia. I am not aware that this process was ever worked, and I believe it is now of purely historical interest.

I found with regard to the mutual action of calcium carbonate and ammonium chloride that the decomposition was complete on prolonged boiling in a dilute solution. By taking a very strong solution, however, I did not succeed in producing complete decomposition, although I carried on the boiling with occasional replacement of evaporated water for about two days; it is but fair to add that traces of ammonia were still being evolved.

It would appear from this that in Young's process the chance of the ammonia being evolved became less and less the more he boiled off his water.

I found, by allowing a solution of ammonium chloride to slowly trickle down a tower filled with small pieces of marble, up which steam was being blown, that it was possible to get the runnings from the tower free from ammonia and to obtain solid carbonate of ammonia at the top according to the equation—

$$2NH_4Cl + CaCO_3 = CaCl_2 + (NH_4)_2CO_3.$$

The tower I used was 5ft. 4in. in height, and nearly 2in. in internal diameter.

To quote two experiments :—

Amount of NH_4Cl taken.	Dissolved in water to	Runnings made to	Percentage of total NH_3 in runnings.
5·35 grammes	100cc.	1000cc.	0·16
13·375 grammes	50cc.	1000cc.	less than 0·1

The ammonia in the runnings was estimated by Nessler's solution. Although I started with fairly strong solutions, in the second case about saturated, the steam condensed in the tower diluted the runnings to a huge extent. So that although it is plain that a dilute solution of ammonium chloride is decomposed completely by calcium carbonate, and a strong one is not, or only very slowly, it still remains to determine the precise limit of strength of the solution decomposable by calcium carbonate.

This reaction, worked on the large scale, would, in the ammonia soda process, save the production and pumping in of carbonic acid, for instead of decomposing limestone in kilns to obtain lime and carbonic acid, both of which are used subsequently,—the former for recovering the ammonia from the ammonium chloride liquors, and the latter for pumping into the brine with the ammonia,—the limestone would be at once decomposed by the ammonium chloride liquors yielding both ammonia and carbonic acid simultaneously.

As to whether this process would pay on the large scale is, I think, a question that can only be decided on the large scale.

It may probably be taken for granted that it would scarcely pay to dilute the liquors to such an extent as to drive all the ammonia off by means of limestone. but it would, I believe, be an advantage to use limestone as an accessory to the lime now used.

It is customary, I understand, before treating the ammonium chloride liquors with lime, to allow them to trickle down a tower filled with some inert substance up which steam is being blown, in order to remove all carbonate of ammonia, existing as such in the solution. My suggestion is that this preliminary treatment should be conducted in a tower filled with limestone, marble, dolomite, magnesite, or other convenient form of carbonate of lime or magnesia, when not only the carbonate of ammonia existing as such in the liquors would be recovered, but a considerable proportion of the ammonium chloride would be converted into ammonium carbonate—I should anticipate to the extent of about two-thirds. This would save two-thirds of the limestone burning and two-thirds of the carbonic acid pumping, and would, moreover, be a neater arrangement.

Liverpool Section.

The next meeting will be held on Wednesday evening, 13th January, when some miscellaneous communications will be read, and objects of interest exhibited.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Manchester Section.

Meetings, Session 1885—86.—First Tuesday in each Month, at 7 P.M.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

INDIARUBBER AND ITS DECAY.

BY WILLIAM THOMSON, F.R.S.E.

Comparatively little accurate information has been published respecting indiarubber, considering its commercial importance and the scientific interest it possesses.

Pure rubber is a white substance having a specific gravity somewhere about ·915, and the purest commercial Para indiarubber has also a white, milky appearance, but on exposure to the air the surface gradually darkens in colour until it has become nearly black. It is soluble in the cold in carbon disulphide, and it is said to be still more soluble in carbon disulphide to which 5 per cent. of absolute alcohol has been added. It is also soluble in chloroform, naphtha, turpentine, and benzene.

Indiarubber at the ordinary temperatures of the air is soft and elastic, but if cooled down to the temperature of melting ice it becomes hard. If a piece of indiarubber be left stretched at the ordinary temperatures of the air, by means of a weight it will contract and draw up the weight if the temperature be increased to, say, 100° F., as shown by Dr. Joule and Sir W. Thomson. When heated to about the boiling point of water, it becomes soft and loses its elasticity. About 300° F. it begins to become still softer and to decompose, and about 400° F. it melts into a viscid liquid which never again becomes solid. This liquefied indiarubber is said to have the same percentage composition as pure indiarubber, which, according to Faraday, contains 87·5 per cent. of carbon and 12·5 per cent. of hydrogen, which gives nearly the empirical formula of turpentine ($C_{10}H_{16}$). Indiarubber may be regarded as one of the terpenes, being evidently some polymeric modification of the radical above mentioned.

To counteract the objectionable properties of ordinary indiarubber, of losing its elasticity when subjected to considerable degrees of cold or of heat, a process called vulcanisation was introduced by Hancock about 40 years ago, which consists in chemically combining the rubber with a small percentage of sulphur. This is done by a number of different processes. If the rubber be immersed in liquid sulphur, according to Mr. T. Bolas, it absorbs as much as 50 per cent. of its weight of that material. This absorption of sulphur, however, does not bring about vulcanisation, because it has only been taken up by the rubber as a sponge would absorb water. If, however, sulphur be introduced into the rubber by this method, or by mechanical means, as is actually done in the manufacture, by intimately mixing the rubber with sulphur, by passing the mixture repeatedly between rollers, after the rubber has been brought into the consistency of putty by mastication,

or after it has been made soft and putty-like, by previously mixing the masticated or ordinary washed rubber with naphtha, the chemical combination of the sulphur and rubber may then be brought about by subjecting the mixture to a temperature of at least 275° F. Part of the sulphur, about 2 or 3 per cent., combines chemically with the rubber and completely changes its properties, producing vulcanised indiarubber.

The molecules of sulphur in excess in indiarubber move about to some extent after vulcanisation, and if too great an excess of sulphur is contained in the rubber employed for waterproofing certain kinds of cloth, which are covered by a mixture of rubber and sulphur and vulcanised by heat, where a smooth black surface is required, the excess, if too large, finds its way to the surface and forms a white bloom on the face of the rubber, which is considerably damaged thereby. After vulcanisation the rubber becomes more elastic than the raw material, and it retains that elasticity when cooled to the temperature of ice, or when heated to the temperature of boiling water. Thin layers of indiarubber may also be vulcanised by applying to it a mixture of sulphur chloride dissolved in carbon disulphide, according to the patent process of Parke, which is employed for vulcanising of the thin layers of Macintosh when heat would be liable to injure the cloth or the colours.

According to Professor William Allen Miller's extracts from the report of a joint committee appointed by the Lords of the Committee of Privy Council of Trade, and by the Atlantic Cable Company about the year 1860, to inquire into the construction of submarine cables,* pure virgin indiarubber is less liable to undergo decomposition than masticated rubber, and I have been informed by Mr. Joseph Mosley, one of the firm of large indiarubber manufacturers of Manchester, that from his experience good Para virgin indiarubber will remain in good condition for any length of time, provided it be kept at the ordinary temperatures of the atmosphere and not exposed to the direct sunlight. The more it is worked or masticated, or if it be over-vulcanised, the greater liability is there afterwards of its decaying. Over-vulcanised rubber thread may be detected by attaching a given weight to any given length of thread of a certain count. The weight ought to stretch the rubber, if properly vulcanised, to a certain length; if however the rubber be over-vulcanised the thread will not stretch to the required length, and if it be under-vulcanised it will stretch farther than the required length. Indiarubber goes on combining with sulphur if the vulcanising process be continued till the caoutchouc is converted into ebonite. Well-vulcanised caoutchouc, after the excess of sulphur has been removed by boiling with caustic soda, is found to contain from 2 to 5 per cent of sulphur; but there is no basis for any theoretical quantity of sulphur being required. The decay of indiarubber was attributed by the joint committee in their report to the direct oxidation of the material of the rubber, and this oxidation Dr. Miller considered was most rapidly and completely brought about by the action of the sun's rays, when the rubber was exposed to the air.

When pure indiarubber was exposed by him to the action of the sun and rain in the open air during nine months, it gradually became blackened and rotten, but it neither became sticky nor hard. It had, however, increased in weight to the extent of 7 per cent. In rubber, however, which he exposed to direct sunlight and air, but which was kept dry in a bottle placed mouth downwards, the oxidation was less rapid, the weight having increased by 2·8 per cent. It had become brown, soft and sticky, especially at the parts most exposed to the light. He found that rubber which had been masticated, was still more acted upon by the light and air, so that during nine months it had been converted into a sticky mass, which had lost its tenacity and elasticity, whereas pieces of vulcanised rubber were, according to his experiments, less acted upon by the sun and air during the nine months than either the virgin or the masticated rubber.

If a thin film of virgin indiarubber be exposed to the direct sunlight for a few minutes, the oxidation or decomposition which goes on, may be observed by its becoming sticky, but I have never observed this stickiness to be produced by the decay of vulcanised indiarubber, unless after it had come in contact with some kind of oil.

I have always observed that vulcanised rubber in decaying first becomes more easily broken when stretched, although retaining its original softness, and then it gradually becomes hard and brittle from the outside inwards. I have also observed that this oxidation is brought about very rapidly by leaving rubber exposed to the air at a temperature near to that of boiling water. It then rapidly increases in weight to the extent of from 4 to 8 per cent., and becomes almost as hard as, but more brittle than, ordinary vulcanite, which is produced on the large scale by heating the rubber to a temperature of about 280° F., with about half its weight of sulphur. It is possible that keeping indiarubber at the temperature of boiling water for some time, brings about not only oxidation, but also an increased amount of vulcanisation, because the rubber so treated becomes harder than any samples with which I have met which had undergone change by exposure to direct sunlight and air, or that which had gradually hardened out of contact with the direct rays of the sun.

It is stated by several authorities, that indiarubber is of a cellular structure; and it is doubtless the case, as may be seen by the microscope, that indiarubber, which has been partially dissolved in naphtha, and formed in sheets for the manufacture of rubber thread, is full of minute air spaces or bubbles. These spaces can most easily be observed after the rubber has undergone oxidation, which takes place to a greater extent around the walls of each air-cell than in the solid parts of the rubber between such cells. I found, by experiment, that the oxidised or partially decayed rubber acts as a mordant to aniline colours, so that if a fine section of the rubber be steeped in an alcoholic solution of an aniline colour and subsequently washed with alcohol, the walls of most of the air-cells remain more coloured than the other portions of the rubber, and they can then be easily observed. It is probable that the air thus contained within the rubber combines chemically with it, and brings about its decomposition when placed under conditions favourable to such change, because I have ascertained that if rubber be kept immersed in boiling water for several days continuously, it gradually becomes rotten, although it is difficult to understand how any oxygen could come in contact with it from the air, under those conditions, and I think we have yet to learn that caoutchouc is capable of decomposing water. Air is evidently mixed with the rubber during the process of mastication. I have observed that rubber, before mastication, had a higher specific gravity than that after mastication. The masticating process consists in putting the rubber, which has been previously cut into slips and washed between rollers, and dried, into a strong iron box, in which is working a hollow toothed or grooved roller, revolving with a slightly eccentric motion. The washed rubber is kneaded in this apparatus between the roller and th

* Journal of the Chem. Soc., 2nd series, vol. 3, p. 273.

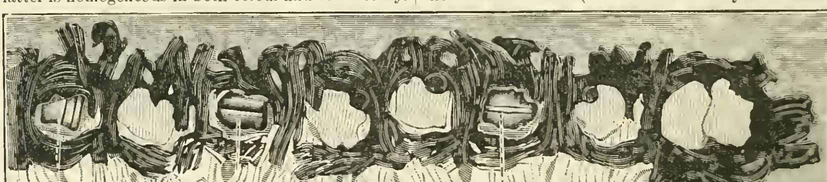
walls of the box for 4, 5 or 6 hours, during which time it becomes sometimes as hot, or hotter than boiling water. Sometimes it is necessary to keep down the temperature by passing water through the hollow cylinder. It is evident that this heat in presence of air or oxygen would also produce oxidation, and bring about direct deterioration in the rubber, and it is possible that such oxidation may be essential to the process; but it would doubtless be a great improvement to the quality of the manufactured rubber if such oxidation could be prevented. One would think from the fact that the decomposition of rubber goes on more readily round the walls of the air cells, that it might be possible to make masticated rubber as little liable to decay as virgin rubber, by the comparatively simple expedient of preventing the formation of air cells and of oxidation by conducting the masticating process in a vacuum, which might be done by laying the heavy doors of the apparatus against strips of vulcanised sheet indiarubber, and attaching the tube of an air-pump to one end of the box for the purpose of extracting the air.

Messrs. James Walton & Sons, of Haughton Dale, near Manchester, the manufacturers of cards for carding cotton, require to make a fabric for holding the steel wire teeth of the card by cementing a layer of sheet indiarubber on to a layer or layers of textile fabric. To produce sheets of rubber which will have a longer life-time than masticated rubber, they simply put the washed raw rubber, after being dried, into a cylinder heated to the temperature of boiling water, and force up a piston by hydraulic power to press the whole together into a solid mass. This cylinder of rubber is then frozen hard, placed in a machine adjusted so that knives cut from it a continuous sheet like the unwinding of a roll. This kind of sheet may be distinguished from the masticated sheet by the former being patchy in colour, though perfectly homogeneous in consistence, whilst the latter is homogeneous in both colour and consistency.

whole of the warp threads into series of knuckles or loops, which stood out from either side of the rubber threads. In some pieces of the web in question, a number of rubber threads became decayed, whilst a number of others remained sound, and it was alleged that the decaying of the damaged rubber threads had been brought about by something injurious to indiarubber which was contained in some of the polished threads which lay on one of the four faces of the rubber thread, and which was absent from the other polished threads which had done no damage. In this case the staining of the rubber threads with aniline colour, and the subsequent washing with alcohol, and microscopical examination threw a good deal of light on the cause of the decay.

To determine this, I cut a piece about 1 inch in length across the web (which was about 6 inches wide), put it into boiling water until all air bubbles had been thoroughly removed from the thread. It was then placed in a solution of previously purified transparent fish glue, then tightly coiled into the form of a cylinder 1 inch long by ¾ inch diameter. This cylinder was then pushed into a cork with a large excess of glue still adhering to it, and allowed to dry. When dry the cork was introduced into a common microtome, into which it had previously been fitted, and fine transverse sections cut from it, which were then stained and washed with alcohol. The rim of cork was then removed from the section, which showed all the rubber and cotton threads *in situ*. The section was then mounted in glycerine jelly for microscopical examination. The following sketch shows part of the section of web, with all the indiarubber and cotton threads *in situ*.

The indiarubber thread in question had been prepared by the usual process of building up the sheet with a series of very fine layers of a mixture of indiarubber, sulphur and naphtha, which was subsequently vulcanised after the naphtha had evaporated; and it is remarkable, on looking at some of the threads shown in the sketch (which was drawn by the *camera*



The six light-coloured threads represent sound rubber threads; the shading round the edges and across the other three threads were crimson-coloured in the original drawing.

Some years ago, I was requested to find the cause of the decay of rubber threads contained in pieces of elastic web. Elastic web is manufactured by stretching the rubber threads as far as the web would be required to stretch, and then weaving it with warp and weft cotton or silk yarns. In the case in question, cotton yarns were employed, which had been purchased from different manufacturers. The web was black on the face and white on the back. The face was formed with black threads which had been polished with paraffin wax. Four of these threads lay lengthwise upon one face of each thread of rubber, and four corresponding white threads lay along the opposite face. Two binder warp threads were woven lengthwise between each rubber thread, and the whole of these threads being fixed by weft threads which went continuously round them.

After the web had been woven with the stretched elastic, it was allowed to contract, thus throwing the

lucida from the microscope), that some of the layers of indiarubber had undergone oxidation before the other layers, and this, along with many other facts, showed that it was quite impossible that the polished threads could have produced the damage. It proved that the rubber was of such a nature as to easily undergo oxidation, and that such oxidation had taken place more in some layers in the interior than in others at the outside, where the polished cotton threads actually touched the rubber, as well as proving that the side of the rubber thread which was touched by the polished threads was not more oxidised or injured than the three other sides, which were not touched by it.

Indiarubber threads fixed in the web in the manner above described, remaining as they do, stretched to some extent, when the web itself is not stretched, are naturally indented with the knuckles of the various series of loops of cotton yarn which lie in contact

with them, so that when the rubber decays and loses its elasticity, the hardened rubber threads, on being removed, retain the impression of these knuckles.

The fact which gave a *prima facie* belief in the polished thread having caused the damage, was that the web manufacturer found several long lengths of web with two or three yards at the end, in which the rubber had decayed and lost its elasticity; and curiously enough, the rubber had commenced to decay at a line of knots across the web, where the polished warp having come to an end, had been joined up to fresh warp threads, all the other warps being continuous over this junction. This web was called "Terry" web; but there was also another "plain" web found by the manufacturer, in which there were no loops of thread covering the face and back; the only threads on that web were the binder warp, lying between each rubber thread, and the polished thread covering both back and front of the rubber threads, as weft. On examining the line at which the good rubber had been joined to the bad across this web, it was observed that exactly the opposite effect was shown, from what one would have expected, had the polished threads caused the damage. The manufacturer observed that a junction of the polished weft thread in this plain web, had taken place in the vicinity of the line across the web at which the rubber threads were damaged. In the "Terry" web, where the rubber was touched only on one face by the knuckles of the polished threads, it was damaged with a sharpness which might be compared to a knife cut; whereas the good rubber in the "plain" web ended in the form of a long wedge, although it was touched upon all four faces by the polished threads. The cause of this peculiar destruction of the rubber was no doubt due to the rubber having been left on the stretch in the looms in an unclothed condition for some time after the polished warp threads had become exhausted. The "Terry" web being better covered at the point at which the weaving was going on, produced a sharper line of damage than that in the plain web, in which the good rubber ended in the form of a long wedge. Rubber thread, when exposed during weaving to the light and heat in an uncovered and stretched condition in the looms, is very liable to undergo decay afterwards, as was shown by an experiment made by Mr. Friswell, of Coventry, who, after exposing the rubber thread in a stretched condition for some time in the loom, had them woven into web, marked, and put aside for some months; and although the rubber appeared reasonably good immediately after being woven, it had, after a few months, become greatly deteriorated, so that after being stretched out to its full extent, the injured parts did not contract like the uninjured, but formed what the manufacturer called a "baggy" appearance. The selvages being composed of two rubber threads, put together, each of which was thicker than those put in the body of the web, these not having undergone oxidation to the same extent as those in the body of the web, contracted to the full extent, the "baggy" appearance between the two selvages being caused by the greater oxidation of the interior threads, which was probably due (1st) to their being thinner, and therefore more easily oxidised, and (2nd) to their having been cut from different sheets of indiarubber, which might have been of better quality; and this "baggy" appearance in the experiment was precisely similar in nature to the damaged "junction webs" in question, because in them the selvage threads also remained perfectly sound.

I think it well to put the facts connected with this case on record, as it may be of interest to manufacturers of such webs; and although the verdict of the arbitrator was to the effect that the polished thread in question had caused the damage to the rubber, yet it is quite clear that in his decision he was mistaken, as might easily have been shown if the arbitrator's reasons for coming to that decision could have been subjected to criticism before a higher court.

I have now had for about six years stretched indiarubber threads in contact with a sample of one lot of polished yarn, which it was alleged had actually caused damage to the indiarubber threads; these I examined a few days ago, and found them to be still quite sound. I chose to stretch the rubber threads in contact with polished cotton warp, because rubber threads which are stretched or pinched or strained in any way, are more easily oxidised at the parts subjected to such strain, than threads in their normal condition.

The sheets of indiarubber from which the threads are cut are white from the excess of sulphur which they contain; this excess is removed after the threads have been cut from the sheets, by placing them for some time in a boiling solution of caustic soda. I have observed in a number of samples of sheets of such rubber where one part of the threads had not had the excess of sulphur removed, whilst the other part was freed from sulphur by the caustic soda process, that the parts so freed from sulphur became quite rotten from oxidation, whilst that containing the excess of sulphur remained sound.

I think the most probable cause of this is that the particles of sulphur are removed. We know *they* do exist and that they *are* removed; and it is probable that when the water in which the rubber has been afterwards washed, evaporates, there remain the spaces which originally were filled with sulphur, and which afterwards became filled with air, the oxygen of which would aid in bringing about the decomposition. That the excess of sulphur occupied considerable space in the rubber threads after vulcanisation, is shown by the fact that one sample which I tested contracted 2½ per cent. on boiling in caustic soda. Completely oxidised indiarubber consists of hard resins, part of which is soluble in caustic alkalis, according to Spiller and to Professor Allen Miller. I have not specially examined this hard resin, but I have noticed that there is a soft amber-coloured viscid substance of the nature of indiarubber, which has been decomposed by heat and which increases in amount as oxidation proceeds. This substance is soluble in ether, and varies from 2 or 3 per cent. in the fresh vulcanised rubber, to 14 or 15 per cent. in that which has been hardened by oxidation; this soft substance is evidently produced simultaneously with the hard resins. I have kept some of it in thin layers exposed to the air for six years, and it now remains as soft as when it was first extracted.

When rubber is undergoing comparatively rapid oxidation or decay, it exhales a characteristic faintly pungent smell; and there is formed from it, besides the hard brittle resins and the soft amber-coloured greasy-looking substance above mentioned, a body volatile at the ordinary temperature of the air, to which the characteristic decomposing rubber smell is probably due, and which condenses on any material, such as white paper, in which the rubber may be wrapped, communicating to the paper an amber-coloured stain.

Vulcanised rubber appears to undergo decay or oxidation throughout before any hardening takes place, the material having, to the eye and to the touch, undergone no change whatever; the fact that it has undergone decomposition may, however, be easily demonstrated by merely stretching the rubber, when it will be found to break easily, whereas it would be quite impossible to break the fresh undecomposed rubber by the hands. According to the researches of Professors Graham Bell and Tyndall, indiarubber which has been highly

vulcanised is transparent to a considerable percentage of some of the solar rays, so that a piece of such rubber interposed between the rays and the selenium plate of the photophone does not prevent some of the rays from finding their way through the rubber, and continuing to alter the electrical resistance of the selenium at the other side. Tyndall says they are heat rays which pass through; still it is easy to understand that they, or the actinic rays, may expend their energy in the interior of the rubber in bringing about a chemical combination of the oxygen in the air-spaces with the rubber in their immediate vicinity; the excess of nitrogen from the air imprisoned in the cells would then soon dialyse out, fresh air with its fresh supply of oxygen taking its place.

Before leaving this part of the subject, it may be of interest to chemists generally to know that rubber corks, or other similar articles, which have become hard on the outside and therefore useless, may have their softness restored by the simple expedient of dissolving away the hard resin by leaving them for some time in a boiling solution of caustic soda.

With a view to find whether direct sun-light would have any action on rubber when placed in contact with gases other than oxygen or in a vacuum, I prepared two years and a half ago a series of experiments by enclosing four stretched rubber threads in each of the following gases: Hydrogen, carbon dioxide, oxygen, air, and in vacuo. One series was made with dry gases, and another with wet gases (a little distilled water being left in each tube), and each experiment was made in duplicate, the whole of the tubes being exposed as long as possible to the direct sun-light each day for several months. In *dry oxygen* all the threads in one of the tubes broke after a few days' exposure to the sun's rays, whilst in the other tube only one thread broke. On examination, a few days ago, all the threads were hardened,—they had not become nearly so hard as those which had been heated at the temperature of boiling water for a few days, but they were quite inelastic; the stretched threads, on being broken away from the frame in which they were stretched, remained quite rigid.

The volumes of the gases in which the rubber threads were enclosed ranged between 240 and 270 grains measure, and the weight of the rubber taken in each experiment was 1¼ grain. In the dry oxygen about 20 per cent. of gas remained in the tube, the rest having been absorbed by the rubber, and by the iron wire frame, which unfortunately was used in these experiments. The gases left were roughly examined in test tubes, so that I will not give the results more minutely than by saying first, that most of the remaining gas was oxygen, and second, that carbon dioxide was present in small or in very small quantity.

I was less fortunate in my experiments with oxygen in presence of water, because in both tubes all the oxygen had been absorbed—mainly, no doubt, by the wet iron wire frames, so that in one tube there was almost a perfect vacuum, and the rubber in it was apparently not acted upon at all, whilst in the other tube the rubber threads were only rendered brittle, so that they could be broken easily when stretched; they retained, however, all the softness of good rubber threads.

In dry air the rubbers were quite rotten, but as soft as good rubber; they curled up when broken as rubber threads always do when they oxidise in a stretched condition.

The threads in dry and wet carbon dioxide were quite sound, likewise those in dry hydrogen, and in one of the tubes containing wet hydrogen. In the other tube containing wet hydrogen the threads were rotten, but I will not be positive that it actually decayed in presence of hydrogen, in case there might have been some mistake, which I have reason to believe possible, I intend this experiment shall be repeated.

The threads which had been kept in vacuo appeared to be as sound as when first introduced, if not tougher and stronger.

From the above experiments it is evident that for practical purposes, so long as rubber can be kept away from the action of air or oxygen, it may be submitted to the action of direct sun-light, and another series of experiments showed that it might similarly be submitted to the action of the heat of boiling water, in presence of hydrogen, carbon dioxide, or in vacuum, without undergoing decay.

It might here be well to consider the method adopted by the natives in collecting crude Para rubber, which commands the highest price in the market. For this purpose, the milky juice of the rubber tree which flows from the incisions made in the bark, is collected in vessels like pails; a fire is made under a large earthenware pot, into which the nuts of the tree *Attalea Excelsa* are thrown at intervals; there is thus liberated from the nuts a heavy white smoke. A wooden bat is covered with soft clay, then dipped into the juice from the tree, which is of the nature of milk, and dried over the white smoke.

I have examined this white smoke, by distilling some of the nuts and condensing the vapour, when I obtained a watery liquid containing acetic, and a liquid dark coloured matter of an oily appearance. The acetic acid would no doubt aid in the coagulation of the juice of the tree, whilst some of the heavier oily-looking liquid would also condense over each layer of the dried juice. This oily substance I have found by experiment to have no injurious influence on indiarubber. Some partially vulcanised sheet-rubber was covered with this liquid, but it did not make the rubber swell so as to rise in a blister where it had touched, as happens with all the oils with the exception of castor oil. It remained liquid on the surface for two or three weeks, and gradually dried up to a pliable very dark-coloured varnish, which exhaled the peculiar aromatic odour of Para rubber. It is evident that this material, condensing on each layer of rubber on the bat of the native, must tend to fill up any pores, and thus tend to prevent the access of air to the body of the material, and render it more durable. Other methods are employed, which consist in precipitating the rubber from the milky juice by means of water, of dilute sulphuric acid or of alum. Thus precipitated, caoutchouc separates as a clot, which is simply allowed to dry, but which does not furnish the first qualities of the material. It would be interesting to learn whether the juices of caoutchouc trees, found in other parts of the world, if treated in a manner similar to that employed for the preparation of raw Para rubber, would furnish caoutchouc less liable to decay, and consequently of greater value, as it is probable that this mode of collecting and drying the juice has much to do with the quality and preservation of Para rubber.

The action of oils on caoutchouc is far from being thoroughly understood, although every one knows that many of them have a highly injurious effect upon it. It was, and possibly is yet, held by one or two chemists that oils put in small quantities on indiarubber tends to soften it at first, and afterwards to make it become hard by bringing about rapid oxidation. Six or seven years ago I commenced several series of experiments, by putting a large number of different oils on good vulcanised rubber thread. On some, one face of the rubber thread alone was painted over with the oil; the amounts put on the rubber varied from 1 per cent. to 100 per cent., or 200 per cent. on the rubber taken. I have examined all these a few days ago. Those which received the

small quantities of the different oils are quite sound and elastic to-day. Some of those which received the large quantities of oils are easily broken, but still soft like the original rubber thread, whilst few have become of a soft putty nature, having lost their elasticity. The conclusions at which I have arrived are that when certain oils are put in large quantity on rubber they have a strong tendency to induce oxidation in the rubber, which, with the oil, becomes of the nature of jelly; and if the rubber is really of good quality it remains in its expanded condition, due to the mechanical influence of the oil which it has absorbed, remaining elastic but easily broken when stretched. If, however, rubber in this condition be exposed to direct sun-light, or to a temperature of say 120° to 200° F. for a few days or weeks, it soon oxidises and becomes of a soft jelly nature, or melts at the higher temperature into a viscid liquid which ultimately hardens if kept at the temperature of boiling water; but in no instance have I found that any oil when applied to rubber thread tended to make the rubber become hard when left at the ordinary temperature of the air in England, although I have done all I could to bring about such a result. If treated with drying oils, they of course might harden in time, that being due simply to the drying of the oil. I have further observed, when rubber thread was treated with some of the more injurious oils, and left in a heap in an envelope, that the parts which were outside and came most in contact with the air and light were softer or were more of a jelly consistence than the parts better covered; and I have further noticed that a piece of rubber so jellified, which I had put into a test tube, remained equally soft and jelly-like during six years. This jellifying or liquefying of the rubber when in contact with oil is brought about by the action of the oxygen of the air on the rubber, which may be illustrated by the experiments I show. Some good rubber thread was left in cotton-seed oil for four days, and when taken out it was found to be much swelled, but still comparatively firm and elastic. Four pieces of the thread were cut off and placed in four tubes, which were filled respectively with air, oxygen, carbon dioxide and hydrogen, and then hermetically sealed. These were made in duplicate; one set was placed in an incubator at 90° F., whilst another set was put into a bath at 200° F. The pieces of rubber in air and in oxygen became quite liquid in both sets, in the first set after a few days, and in the second within a few hours; whilst those in hydrogen and in carbon dioxide retained their form unaltered, even after being heated for a week at 200° F. About the end of the year 1883, I placed equal lengths of vulcanised indiarubber threads (2 inches) into different oils contained in test tubes, and left them where they would be heated to a temperature of from 80° to 110° F. for several hours each day. Here they were left for ten months, and on being examined it was found that the pieces of rubber contained in sperm oil, tallow oil, English neatsfoot oil, and American neatsfoot oil, were completely dissolved; these oils, though remaining quite fluid, had become more or less viscid.

Cotton-seed, olive, cod-liver and pale seal oils, had all swelled the rubber so much that it was rather difficult to see that they had not been dissolved, but in none of the last-mentioned had solution really taken place. The threads were laid in a U form from the bottom of the test tubes, the ends of the thread projected a little above the surfaces of the oils, and it was curious to notice that the parts of the threads at the immediate surface in the last-mentioned list of oils were completely dissolved away, whilst the pieces under the surface had swelled out to about two or more times the thickness of the original threads, and were exceedingly soft and jelly-like, but had not dissolved.

The piece of rubber in castor oil had apparently not been acted upon, so that after ten months it was as good and elastic as when it was first immersed. But when examined a few days ago (after being immersed for upwards of two years), and kept, as before stated, at a high temperature for several hours each day, it was then quite elastic and soft, and apparently quite sound; but it was really not quite sound, because when stretched it would not bear as much strain without breaking as the original rubber thread. Linseed oil stood next to castor oil in this series as having acted least on the rubber thread. No part of the thread appeared to have dissolved in the linseed oil, although it had swelled up and become gelatinous.

Generally speaking, the oil which is most destructive to the elastic properties of indiarubber when saturated with the oils and exposed to warm air is palm-nut oil and palm oil, some varieties of which have much greater effect than others. Thinking that this might be due to the fact suggested to me by my friend Mr. Percy J. Winser, that some palm oils contain a much larger quantity of free fatty acids than others, and that the difference might be due to the free fatty acids, I estimated the amounts of free fatty acids in each, and found that the percentages did not explain the difference in the action of the different oils. Bleached palm oil, which had greatest effect on the rubber, contained 37·2 per cent. of free fatty acids, calculated as palmitic acid. The Bonny palm oil, which had least action, contained 31·1 per cent., whilst a sample of palm oil, which stood between these two in its action on rubber, contained 65·8 per cent. of free fatty acids. Palm-nut oil, which had more injurious action on rubber than any of the samples of palm oil, contained 13 per cent. of free fatty acids. The oil which had least action on rubber was castor oil.

Some time ago I examined a case of damage which might be of interest to indiarubber manufacturers, or those otherwise interested in it. Waterproof cloth is sometimes made by taking two layers of tweed or woollen cloth, covering each with a thin layer of indiarubber, which is then slightly vulcanised by the cold process; the two rubber layers are then laid together and pressed between rollers, so that they adhere firmly. Waterproof cloth thus made was shipped abroad to a warm country, and on arrival there it was found that the two pieces of cloth of which the waterproof fabric was composed had separated from each other, the rubber having become quite soft and sticky, and having become absorbed into the substance of the woollen. It became a question what had caused this; the person who bought the cloth and sent it to be waterproofed alleged that the rubber manufacturer had put in bad rubber, whilst the latter believed that there was something in the cloth which had caused the damage. I requested to be supplied with two pieces of the original cloth, which had not been treated, but the same as that which had become damaged after treatment, and fortunately I obtained them from the rubber manufacturer. I divided each into two parts, and from one of each I extracted the oily matter present by means of ether—

The one Sample contained .... 1·37 per cent. of oil
And the other .... ·84 „ „

No difference could be observed between the pieces from which I had extracted the oil, and the others, which were in their original condition. I marked them by different letters of the alphabet, and sent them to the manufacturer, requesting him to cover each with rubber in the usual way, and then to fold each on itself, the indiarubber layer being inside; these would then produce four pieces of waterproofed material. These so treated I obtained from the manufacturer, and placed them in an incubator at a

temperature of about 110° F. for about eight hours each day for fourteen days. On looking at them after that time, I found that two of the pieces were perfectly sound, and that it was impossible to separate the two layers from each other; whilst the layers of the other two pieces could be separated from each other, the layers of the one with 1·37 per cent. of oil separated easily, whilst that with ·84 per cent. of oil with some difficulty, the rubber which bound them together having become quite sticky in each. I then referred to the marks on the pieces, and found that the two from which I had extracted the oil were perfectly sound, whilst those which had not been so treated had become useless as waterproof material. It may be thus taken that the small percentages of oils given above left in cloth which has to be waterproofed, will in all probability rapidly determine the decay of the rubber, especially if shipped to warm climates; and it might be well for manufacturers to treat small pieces of such cloth, and expose them to the temperature of boiling water for a day or two before treating the larger pieces.

If cloth which is required to be covered with a layer of polished rubber contains much oil—say a little over 1 per cent.—it is liable to produce dull spots and stains all over the face of the layer of rubber on polishing.

With a view to obtain further information respecting the action of oils and other liquids which are capable of acting on vulcanised indiarubber, I took two rubber threads; the one was of count 34 and the other count 32—in other words, thirty-four pieces of the one, or thirty-two pieces of the other thread, when laid closely together would measure one inch. Both threads had been vulcanised, but the 34 count thread still retained the excess of sulphur, whilst it had been removed from the 32 count by a boiling solution of caustic soda. Two inches of the first thread, and three inches of the second were weighed and put together into each test tube, which was then half-filled with oil or other liquid to be tested, which completely covered the threads. The whole series was then left in an incubator at a temperature of 84° F. for exactly twenty-four hours, the tubes containing volatile liquids being corked, and all were again accurately measured and weighed after being dried thoroughly with blotting paper, and returned to the tubes for three days more, and again accurately measured and weighed as before. The table on page 717 gives the results of these experiments, calculated on 100 parts. The first two columns give the measurements of the first and second threads respectively, after twenty-four hours and after four days, the results given for four days being placed in different style of figure from those after one day, so that they may be the more easily compared. The third and fourth columns give the *weights of oil* which 100 parts by weight of rubber absorbed, and the fifth and sixth columns give (by calculation) the amounts of the different oils which would be required to expand the rubber to double its original length, assuming that such could be done. As a matter of fact, none of the substances employed expanded the rubber to double its length; but this arrangement of calculation is convenient, as it shows by merely altering the decimal point the relative weights of the different oils required to make 100 parts by measure of the same rubber thread expand to 101 or to 110 parts.

It is evident from these results that to some extent the placing a piece of rubber thread in an oil for a day or two, and measuring and weighing it, may become of use as a test for different oils, or for adulteration of oils.

The threads after being removed from the oils and other liquids (after being immersed for 4 days) were placed in glass tubes, which were afterwards filled with oxygen, and hermetically sealed and placed in a bath at 200° F.

After six hours the pieces of rubber saturated with the following oils had become quite liquid :—

Tallow Oil.	Solid Palm-nut Oil.
Solid South American Kidney Tallow.	Melted Palm-nut Oil.
Melted South American Kidney Tallow.	Olive Oil (Saville).
Pure American Neatsfoot Oil.	Olive Oil (Boiled).
Pure English Neatsfoot Oil.	Refined Cotton-seed Oil.
Melted Palm Oil.	Rape Oil.
Melted Bleached Palm Oil.	Pure Oleine.
	Rancid Gallipoli Oil.
	Turpentine.
	Paraffin Oil.

The following oils partially liquefied the rubber after 6 hours in oxygen at 200° F. :

East Indian Fish Oil.	Solid Palm Oil.
Pale Seal Oil.	Solid Bleached Palm Oil.
Sperm Oil.	

The following oils, etc., *appeared* to the eye not to be altered after 6 hours in oxygen at 200° F. :—

Pure Cod-liver Oil.	Oil of Cloves.
Solid Bonny Palm Oil.	Mixture of equal parts of Rosin and Cod-liver Oils.
Melted Bonny Palm Oil.	Naphtha.
Cocoa-nut Oil.	Benzene.
Castor Oil.	Carbon Disulphide.
Raw Linseed Oil.	Benzoline.
Rosin Oil.	Alcohol.
Mineral Oil.	Ether.
Creosote Oil.	Pyroligneous Acid.
Butter Fat.	Acetic Acid.
Water.	
Free Acids from Castor Oil.	

After continuous heating for 24 hours. The following, which were partially liquid, or not altered after 6 hours, had become completely liquefied :—

Sperm Oil.	Rosin Oil.
Solid Palm Oil.	Mineral Oil.
Solid Bleached Palm Oil.	Butter Fat.
———	Mixture of Rosin and Cod-liver Oil.
Solid Bonny Palm Oil.	Naphtha.
Melted Bonny Palm Oil.	
Cocoa-nut Oil.	

After 8 days' continuous heating, East Indian fish oil became liquid, whilst the remainder became hard, not having altered materially as judged by the eye, but they had become hard by the prolonged heating and oxidation :—

Pure Cod-liver Oil.	Benzene.
Castor Oil.	Benzoline.
Fatty Acids from Castor Oil.	Carbon Disulphide.
Raw Linseed Oil.	Pyroligneous Acid.
Creosote Oil.	Acetic Acid.
Water.	Ether.
Oil of Cloves.	Alcohol.

Ozonised air has but little action on unstretched or unstrained rubber, but it acts very rapidly on rubber in the stretched or strained condition.

It would be valuable to have some reliable but rapid tests for discovering whether indiarubber manufactured at different times is up to any given standard so far as length of life is concerned. Over-vulcanised rubber hardens rapidly by oxidation, although there are other things in the nature of the rubber which appear rapidly to determine its decay. I have obtained some interesting relative results by placing rubber threads, stretched on a piece of wire gauze, which was placed over a vessel containing turpentine. The ozone and peroxide of hydrogen, which is produced from the turpentine, determine the decay of the rubber after a few weeks, but it might perhaps be employed by putting the rubber threads to be tested side by side in a stretched condition on a frame, and placing the frame thus charged in a tube heated to a constant temperature, of say 150° F., which

TABLE SHOWING THE ACTION OF DIFFERENT LIQUIDS ON INDIARUBBER.

		Indiarubber Thread (Vulcanised). 100 Parts by				Calculated Weight of Liquids required to expand 100 parts of Rubber Thread to 200 parts.	
		Measure become		Weight absorb			
		1° Thread contains excess of Sulphur.	2° Thread excess of Sulphur removed.	1°	2°	1°	2°
1. Turpentine	1 day	185	182	541	531	610	647
	4 ,,	190	191	604	689	671	647
2. Naphtha	1 ,,	173	174	409	477	560	611
	4 ,,	178	183	420	503	538	606
3. Carbon disulphide	1 ,,	173	170	680	779	931	1110
	4 ,,	178	175	680	781	872	1040
4. Benzene	1 ,,	173	170	441	472	604	674
	4 ,,	177	179	467	486	606	615
5. Rosin Oil	1 ,,	161	161	313	378	562	619
	4 ,,	185	186	521	571	612	664
6. Paraffin Oil	1 ,,	159	157	283	280	479	491
	4 ,,	159	157	286	282	485	494
7. Palm-nut Oil (melted)	1 ,,	149	147	225	238	459	507
	4 ,,	212	191	334	304	298	334
8. Creosote Oil	1 ,,	149	155	230	309	469	566
	4 ,,	155	157	271	317	492	656
9. Mixture of Cod-liver & Rosin Oils	1 ,,	149	149	245	262	500	534
	4 ,,	159	166	288	304	488	642
10. Pure Oleine	1 ,,	137	143	115	200	391	465
	4 ,,	159	159	293	288	496	488
11. Bonny Palm Oil (melted)	1 ,,	137	139	130	164	351	420
	4 ,,	142	143	163	200	351	401
12. Sperm Oil	1 ,,	143	146	156	185	362	402
	4 ,,	159	156	306	285	618	508
13. Benzeline	1 ,,	113	113	204	201	474	474
	4 ,,	154	157	207	236	383	414
14. Mineral Oil (lubricating)	1 ,,	143	143	178	200	411	465
	4 ,,	146	145	174	201	378	446
15. Ether	1 ,,	136	137	107	127	297	313
	4 ,,	187	176	116	146	133	194
16. South American Kidney Tallow (melted)	1 ,,	134	138	141	161	414	423
	4 ,,	149	154	218	248	444	459
17. Cocoa-nut Oil	1 ,,	131	137	117	161	344	443
	4 ,,	134	139	130	176	382	451
18. Bleached Palm Oil (melted)	1 ,,	128	129	86	116	307	400
	4 ,,	149	154	216	223	438	413
19. Palm-nut Oil (solid)	1 ,,	128	131	95	147	339	432
	4 ,,	164	161	282	325	440	532
20. Olive Oil (boiled)	1 ,,	128	131	91	128	325	413
	4 ,,	146	149	191	222	416	453
21. Palm Oil (melted)	1 ,,	125	129	89	115	356	396
	4 ,,	162	154	218	217	388	465
22. Cod-liver Oil	1 ,,	128	131	100	133	359	429
	4 ,,	137	142	137	158	370	376
23. Pale Seal Oil	1 day	131	125	84	128	271	512
	4 ,,	134	137	124	155	364	407
24. Tallow Oil	1 ,,	125	131	98	114	392	367
	4 ,,	146	149	168	225	343	459
25. Olive Oil (Saville)	1 ,,	125	128	87	123	318	439
	4 ,,	149	149	198	242	404	493
26. North American Neatsfoot Oil	1 ,,	125	131	96	119	384	384
	4 ,,	146	145	193	216	419	480
27. Pure Neatsfoot Oil	1 ,,	125	131	93	126	372	406
	4 ,,	134	136	95	144	279	411
28. Bonny Palm Oil (solid)	1 ,,	125	131	89	128	356	413
	4 ,,	131	136	113	135	364	400
29. Refined Cotton-seed Oil	1 ,,	125	128	96	119	384	425
	4 ,,	149	147	226	239	461	508
30. Rape Oil	1 ,,	125	128	78	109	312	389
	4 ,,	143	143	167	216	388	602
31. Rancid Gallipoli Oil	1 ,,	121	128	82	119	390	425
	4 ,,	134	135	145	181	426	517
32. Raw Linseed Oil	1 ,,	121	125	76	109	362	436
	4 ,,	143	142	163	182	379	433
33. East Indian Fish Oil	1 ,,	118	118	65	90	305	500
	4 ,,	125	129	82	116	328	400
34. South American Kidney Tallow (solid)	1 ,,	116	118	60	85	375	472
	4 ,,	131	136	110	152	354	434
35. Butter Fat	1 ,,	112	133	140	150	416	451
	4 ,,	134	137	150	165	441	446
36. Oil of Cloves	1 ,,	112	114	45	62	375	443
	4 ,,	112	116	45	64	375	460
37. Bleached Palm Oil (solid)	1 ,,	112	118	45	74	375	441
	4 ,,	125	129	82	116	376	400
38. Palm Oil (solid)	1 ,,	109	112	21	52	233	433
	4 ,,	118	121	56	85	311	404
39. Fatty Acids from Castor Oil	1 ,,	103	108	11	26	376	325
	4 ,,	106	108	14	34	226	425
40. Acetic Acid	1 ,,	103	104	15	12	500	300
	4 ,,	106	106	20	24	333	400
41. Absolute Ethyl Alcohol	1 ,,	103	104	0	3·2	—	80
	4 ,,	100	104	0	4	—	100
42. Pyroligneous Acid	1 ,,	103	102	12	11	386	570
	4 ,,	106	104	12	16	193	410
43. Water	1 ,,	103	102	7	9	240	475
	4 ,,	103	104	14	14	466	350
44. Castor Oil	1 ,,	97	100	—	9	—	—
	4 ,,	100	102	—	1·6	—	80

might easily be done by aid of a thermostat, and allowing a little turpentine vapour to constantly pass up the tube and impinge on the thread, or other form of rubber suspended in the heated tube, and then to try their relative strength after any given time.

I have to thank my assistant, Mr. William L. Gadd, F.C.S., for the very able and careful manner in which he has worked out the experiments on the action of oils and other liquids on indiarubber.

The Second Meeting of the Session was held on Tuesday, December 1, 1885, in the Rooms of the Chemical Club, Victoria Buildings.

IVAN LEVINSTEIN, ESQ., IN THE CHAIR.

ADJOURNED DISCUSSION ON MR. WM. THOMSON'S PAPER, "THE DECAY OF INDIARUBBER."

The Chairman, in opening the discussion, explained that as Mr. Thomson, at the last meeting, had not sufficient time to do more than give from memory an abstract of his paper, if he desired, he might bring forward any new points before opening the adjourned discussion.

Mr. Thomson then referred to some of the parts of his paper, which he had not time to give at the last meeting.

Mr. Grimshaw: I confess my inability to see where the author and Dr. Burghardt are at issue. The contention of the latter seems to be that with much oil present the oxidation of the rubber proceeds so far as to liquefy it, and that when little oil is present the oxidation renders the rubber occasionally hard and brittle. With this view I am inclined to agree. If strips of pure or vulcanised indiarubber be coated with boiled linseed oil, and maintained at a temperature of 50° C. for a day or two, they become hard and brittle, and assumes a sort of burnt appearance. I think that indiarubber is porous, for it certainly absorbs oil and even water, and that this possibly is favourable to its oxidation. In a paper by Dr. Chandler, of Columbia College, New York (*Indiarubber and Gutta-percha Trades' Journal*, vol. xi. p. 85, November 4, 1885), the following figures are given:—"In 30 days thin sheets of caoutchouc absorbed from 18·7 to 26·4 per cent. by weight of water, and the volume increased about 1·5 per cent. In 8 days similar sheets absorbed 18 per cent. of anhydrous alcohol, and increased in volume 9·4 per cent." There are two ways of making the thread such as Mr. Thomson used in his experiments. In one the masticated rubber is formed into a solid block, then cut into thin sheets, which are again cut into strips of square section. In the other, a solution of rubber in naphtha is spread on sheets of cloth, and allowed to dry. The thin covering of rubber thus obtained is stripped off and cut into threads or strips. This latter process is most commonly employed, because it has been found that threads so made last longer than those made by the other method. I attribute this to the greater porosity of strips cut from a solid block. We ought to have more analyses of indiarubber and gutta-percha. Of indiarubber we have some by Faraday, some in Miller's Handbook of Chemistry, and those made by Dr. Burghardt, and quoted in his paper on the subject.* Of gutta-percha, to the best of my belief, there are none at all.

Mr. Rowley: I understand the author to state that oil has little or no effect on rubber at the ordinary temperature. I have been engaged in the manufacture for thirty years, and I cannot agree with him. Waterproof cloth is made by spreading a layer of rubber, which has been dissolved upon a piece of woollen cloth, known in the trade as "tweeds." Finishers of tweeds use a small percentage of oil in dressing, but even a very small percentage suffices to injure the material for waterproofing purposes. 4 or 5 per cent. of oil, especially such oils as are liquid at ordinary temperatures, suffices to decompose the finest indiarubber in about six weeks, when it becomes quite sticky. It is well known that Para rubbers are the best, and that African rubbers are much inferior to them. Is it possible to improve the latter by any chemical process? As regards the cells or pores said to be in the rubber, is it not likely that these are due to the removal of sulphur by the caustic soda process?

Mr. Grimshaw: I would like to add that woollen cloths, which are used for Macintosh making, are not dressed with pure vegetable oils, but with a mixture containing from 10 to 20 per cent. of mineral oil. It is this mineral oil which dissolves the rubber, and account must be taken of the amount present in forming any conclusion as to the causes of oxidation.

Mr. Davis: I can endorse Mr. Grimshaw's remarks. There is a large trade in paraffin oil for this purpose.

Dr. Burghardt: I am very pleased to see that Mr. Thomson has carried his investigations further than I anticipated at the last meeting. I can only say that he has worked out his experiments in a manner different from my own. While he immersed the thread, and kept it in oil for a time, and got a series of results which are interesting, I take it that my results are more practicable from a commercial point of view, as showing the cause of damage to indiarubber in the way of trade. I applied the oil on the surface, and exposed it to the air. Mr. Thomson obtained a sticky kind of decomposition with an excess of oil, but in my experiments, with a small quantity of oil, I reached the sticky stage first, and later on a hard condition, and if Mr. Thomson had allowed his experiments to continue, I have not the least doubt that the indiarubber would have become resinous, and had he analysed it, he would have found that the oxygen had very much increased.

Mr. Carpenter: I think that Dr. Burghardt and Mr. Grimshaw's remarks as to the resinification of indiarubber may help to throw some light upon the subject from another source. Mr. Grimshaw states that if indiarubber be coated with linseed oil it becomes brittle, hard and rotten, whilst Dr. Burghardt refers to the softening effect produced by the oil. I think that temperature has an influence.

Mr. Thomson said in reply: It is possible that by placing oil on indiarubber it will become first soft and afterwards hard, but that, in my opinion, is simply due to the fact of using a drying oil. Otherwise, the indiarubber will remain soft and sticky for many years. Mineral oils are among those which have the least action on rubber, so far as oxidation and softening are concerned, and if it be necessary for woollen cloth, which is to be used for Macintosh, to contain *any* oil, the mineral oil, which Mr. Davis says is much used for treating woollens, is one of the least objectionable, whilst cotton-seed and olive oils would be among the most injurious. The least objectionable of all would, of course, be castor oil. I agree with Mr. Rowley's suggestion, that by submitting the vulcanised rubber to a boiling solution of caustic soda, the minute particles of sulphur in excess would be removed and air cavities left. These air-cells would then aid in bringing about more rapid decomposition of the rubber than would be the case if the sulphur were not removed. Mr. Rowley also mentions that

* This Journal, ii. 119—122.

he thought that about 5 per cent. of oil, if contained in the tweeds upon which the rubber is spread, would be certain to determine its decay. My experience has been that a much smaller quantity of oil will bring about that result, an amount a little under 1 per cent. being sufficient to make the thin layer of rubber between two layers of tweed soft, sticky and useless, and this is rapidly brought about at a rather high temperature, say 100° F. Mr. Rowley gave a good practical suggestion as regards the difference between Para and African rubbers. No doubt some of the constituents of the African rubbers induce oxidation and decay, and it is very probable that these might be removed, and the quality thereby improved.

DISCUSSION ON MR. DAVIS'S PAPER ON THE VALUATION OF CRUDE NAPHTHAS OF COMMERCE. (This Journal, iv. p. 645.)

Mr. Levinstein quite agreed with Mr. Davis that the usual method of estimating the value of crude naphtha did not accurately show the commercially valuable constituents of that complex body; but he was afraid, on the other hand, that the test he recommended would never be accepted by the trade. In Mr. Davis's process the crude naphtha was first treated with twenty per cent. by weight of concentrated sulphuric acid. Such a large quantity of acid would inevitably absorb a considerable amount of the aromatic hydrocarbons, and the results would therefore give an unjust advantage to the buyer as against the sellers of this article.

Mr. Thomson asked if the author believed in the commercial test usually employed for testing naphthas—viz., by distillation at the rate of two drops per second? Also whether his method would give more accurate results in respect to the separation of liquids of one boiling point from that of another?

Mr. Watson Smith thought that, even supposing the more usual amount of sulphuric acid for washing the naphtha (viz., five to six per cent. by volume) were adopted (of course employing a very thorough system of agitation), then Mr. Davis's method would yield results which would scarcely be acceptable, he was afraid, to those buyers who did not employ dephlegmating columns, and condensing apparatus of so complete a character as those used by Mr. Davis himself, and the employment of which was apparently presupposed in the method of estimation offered.

Mr. Davis: In reply to the remarks made by the Chairman, I admit that I use more acid for refining than most rectifiers, but in my case it does not matter, as I recover, in actual working, the aromatic hydrocarbons which the excess of acid takes up. My reasons for using more are:—First, when entering the market with my benzene, I was told that the Germans washed their benzols better than the English. I obtained samples from Germany and found this was true, and thereupon resolved to eliminate from my benzols the "light stuff" which ordinarily is left in. Secondly, if you operate in the laboratory, with the same proportion of acid used on the large scale, it is impossible to produce similar results, for in the laboratory the quantities used are small, and the heat of the reaction is soon dissipated; while on the large scale there is a great bulk of liquid which is kept for a time in contact with acid at a very considerable temperature. The proportions of acid I have given for use in the laboratory will yield results comparable with those obtained on the large scale when the usual quantity of acid is employed—viz., ten per cent. of the crude naphtha. In reply to Mr. Thomson's query, respecting the distillation test, I think it to be as good a one as can be devised for finished benzols. The test prescribes that the contents of the retort or flask are to be distilled as fast as they can be, so that the distillate shall run in separate drops, and if this is properly carried out there should be no difference in the results of different operators working apart with varying apparatus; but if a less speed be adopted, a low result will be obtained, as the upper part of the flask or retort will not be fully heated, and will act as a rough kind of dephlegmator.

THE VIOLET STAINS FREQUENTLY APPEARING ON SIZED COTTON CLOTH.

BY WATSON SMITH,

Lecturer on Chemical Technology in the Victoria University, Manchester.

The above defect, as it is regarded (though at once and easily removed by washing), was first brought before my notice, about six months ago, by one of the largest and most respected firms of grey cloth manufacturers in this city.

I was requested to investigate the matter and to co-operate with the firm in question, in endeavouring to overcome the difficulty.

It should be mentioned that about a year ago the same firm consulted me as to the safest materials to employ for size-mixing, so as to avoid the risks of mildew. I had recommended that a large proportion of starch (farina) should be used, as being free from nitrogenous matters, and so less likely to favour the development of mildew than a mixture consisting largely or entirely of flour, a substance which is nitrogenous.

I have recently experimented with two samples of size, differing only in that the one contains flour and the other a mixture of flour and farina, in which the latter predominates. They were placed in similar bottles, and these were then corked and left for some days. On opening both bottles the flour size was found with a patch of mildew about the size of a sixpence on its surface, and with a mouldy smell, whilst the size made with farina was not in the slightest mouldy nor had the least smell of mouldiness. Four days later the farina size began to show green spots little larger than mere points. The mould in the flour size had meanwhile considerably developed.

This experiment is by no means irrelevant to the case, as will subsequently appear. The firm stated that for the first six months of this year it had used farina size mixed somewhat as follows: Flour, 560lb.; farina, 672lb.; China clay, 1344lb.; Epsom salts, 672lb.; zinc chloride solution, 20galls. All the cloth sized with this mixture was perfect as regards freedom from stains. Yet, the following month this firm spoiled all the cloth it made with stains, but on altering the mixture in such wise as to eliminate the farina almost entirely (flour, 1400lb.; farina, 224lb.; China clay, 1344lb.; Epsom salts, 672lb.; zinc chloride 36galls.), and later on by removing the farina entirely, almost complete exemption from the stains was secured.

The violet stains referred to, first appear in the warps after sizing and drying, but they show more when the pieces are woven, and are then seen running along the warp threads of cloth in which they appear, and so are not to be confounded with accidental stains of other kinds. They cannot usually be seen by gaslight, and are only clearly discernible when the

cloth pieces are illumined by a top-light, a north-light being considered best. However, here and there in certain pieces, some few stains occur that might be seen even by bright gaslight, but they would not appear violet, but merely dark. They are at once discharged by souring the parts with dilute hydrochloric acid, or even a less dilute acetic acid. Alkalis discharge the violet, leaving light yellowish or yellowish brown stains. The violet stains are easily removed on washing the cloth with soap and water.

The firm which consulted me, informed me that the staining of the warps had been attributed to the presence of the small fragments of the cotton-seed shells in the threads of the warps to which they adhere. The notion seemed to be that these seed fragments contain some colouring matter which exudes in the sizing process, and so stains the warp threads, the seed fragments being technically said to "bleed."

This idea I have proved to be false; the seeds in neither kernels nor shells, contain any colouring matter beyond the usual brown or brownish yellow insoluble matter peculiar to ordinary dried seeds and husks; certainly no blue or violet colouring matter.

I now began to think of tannin in the seeds, and accordingly I examined seed shells and kernels separately for this principle, and found that the shells contain notable quantities of it, whilst the kernels contain only slight traces. If a parcel of cotton warp be examined, the fragments of seed shells adhering to the threads will be soon perceived, and usually I have found on decolourising a violet stain with a drop of ammonia, not only the change to a faint yellow, but a minute fragment of seed shell, forming, as it were, the nucleus of the stain; but the latter is by no means always the case. If a number of seed shells and kernels, finely cut up or ground, be separately boiled for some time with dilute alcohol, light brown solutions are obtained. That of the shells shows by its reactions with solutions of ferrous and ferric salts that tannin is present in considerable quantity; that of the latter, that tannin is present, but only in traces.

Iron is present in the ash of cotton, but I did not consider that of much importance, as it would not be in a condition to give the reaction with tannin. On examining the cotton weft I found this contains but little iron, whereas the sized warps contain much iron. Procuring samples of water used in mixing the size, of the zinc chloride, farina, flour and China clay, and examining them, besides inspecting the apparatus in which the size was prepared, I found the water used was ferruginous; the zinc chloride contained much iron; the farina was an exceedingly pure and beautiful preparation; the China clay very white and of the best quality, and free from iron in a condition to act on tannin; the mixing vessels were of iron, but were afterwards replaced by wooden ones. The water was also changed, and water from the city-supply used.

The conditions were consequently as favourable for the production of violet or really grey spots or stains, as in the case of cloth prepared with iron mordant, and then taken through a sumac bath. That the warps and cloth actually do contain iron, and that at the time of sizing, this iron being more or less in a soluble condition would render the warps extremely sensitive to minute traces of tannin in the shells of the cotton seeds, it will be very easy to show you in an experiment or two. This piece of grey cloth, I shall first sour with very dilute warm hydrochloric acid to bring the iron in it, now for the chief part insoluble as oxide, into the soluble condition it was in when the warps were sized; the zinc chloride used was also slightly acid. I then pass through a bath of very dilute ammonia, to remove excess of acid, and now after rather removing some iron than adding any, I place a drop of tincture of gall-nuts on one part of the cloth, and a drop of tincture or decoction of our seed shells on another part, and the blue grey or violet spots show that tannin is present alike in both cases, and that the cloth at the time of sizing is very sensitive to such presence. Without such preparation, the cloth, dry as it is, will even give faint violet or grey stains with decoction of seed shells.

If I crush a minute fragment of ferrous sulphate (copperas) on the cloth, and add a drop of seed-shell decoction, the violet stain at once appears, after drying by the application of a warm glass plate or tube. There is no doubt that the rollers of the sizing apparatus, the upper one of iron, the lower one surrounded with layers of flannel, in removing the surplus size from the warps, also squeeze out or cause to exude tannin from the shell fragments. There are two possible remedies: (1) To remove all seed shells from warm threads before sizing. (2) To remove iron from all the materials. Both these remedies are very difficult to apply; the first on the whole, I imagine, would be most feasible, but it would involve special machinery. However, with such a firm of engineers and machinists in our city as Messrs. Mather & Platt, whose machinery is to be found throughout the world wherever cotton is spun and woven or calico printed, the problem should be one easily solved by means of some super-added device in the spinning machinery of our cotton mills. Thus, I could imagine warps presented to the sizer quite free from adhering seed fragments. The attempt to keep iron away would mean the constant application of attention in many directions, to keep the tannin away would mean its concentration on one point only. But I have said that when flour is exclusively used, not nearly the trouble is experienced in keeping the stains from view. I say from view, for I believe they are always more or less present.

We come now to consider another question—viz., that of what I will call the "covering power" of the size used. As you know, on boiling up starch and water a transparent solution is obtained—starch paste; this on drying, yields a more or less transparent coating. On sizing with farina therefore, a kind of starch paste is produced more or less transparent, and on drying, the transparency may be such that the "stains" from the seed shells show up through the size. No doubt the addition of large quantities of China clay would confer sufficient body and "covering power" to the size, to give a covering opaque as regards the "stains," so that they shall not show. But the firm I have referred to has always had a name for cloth of a high grade, and it does not wish to use more clay than it has always used before.

Flour gives a paste which is opaque, has considerable body, and on drying yields a coating possessing very considerable body or covering power. But then, as I have already stated, flour size is most apt to mildew. We see now that the manufacturer producing the highest grades of cloth, and using farina size to keep away the danger of mildew, has the greatest difficulties in his way, as far as these seed stains are concerned. With heavier sizing involving the use of more China clay and other materials, it is possible to cover up these stains, even using a size chiefly made with farina.

Yet, the agents and buyers abroad, in China and elsewhere, refuse cloth showing these stains, faint though they be, and practically harmless, possibly mistaking them for mildew in its incipient stages. The first wash with alkaline soap and water removes both the size and the seed stains, the alkalinity of the soap being quite sufficient to remove them. It is not

irrational then to refuse an article of a good substantial make, weight for weight, containing the maximun of real textile fibre, and to prefer one containing less cloth and more size and China clay, because free not from the *reality* but the *appearance* of the stains in question—these being, as stated, removed in the first washing with alkaline soaps and never reappearing. The firm I have referred to has now many thousand pieces thus rendered unsaleable in the market. I well know the demand regulates the supply; the kind of demand also regulates the character of the supply, and so "wisdom is justified of her children"!

Were I judging a parcel of cotton cloth delivered to me, I should argue from the appearance of seed-stains that a light sizing had been adopted, and that probably farina or starch size had been used, and hence that I was getting at all events plenty of substantial cloth, and not size for my money. I have found that these stains *are not stains in the size, but in the cloth*, for on pouring a drop of my decoction of the seed husks on a little size spread out on a porcelain plate I get no slate colour or violet patch produced, as I do on repeating the experiment with a piece of cloth. Hence these stains are in the cellulose fibre and show up, or do not show up through the size. Another idea before I conclude. We know that the various astringents vary in the amounts of tannin contained in them very considerably, and we know also that in one species grown under very different conditions of climate, etc., the amounts of tannin contained may vary just as much in the different varieties of that species, and in some years also the amounts of tannin will even vary in the variety, growing in the same locality, from the amounts in other years. Thus Aleppo galls contain from 60 to 70 per cent. of tannin, whilst English gall-nuts, as I determined in 1869, contain not more than from 20 to 23 per cent. of tannin. Now, is it not possible that also the seeds and seed shells of cottons grown in different climates and under different conditions of country, soils, water, etc., may also vary in the amounts of tannin contained? May, *e.g.*, the cotton-seed shells of American, Indian, and Egyptian cottons not possibly vary considerably in the above respect, and so cause extreme trouble and anxiety to certain cloth manufacturers and sizers, from which others may be exempt? It seems to me the question is worthy of a special inquiry, for there is no doubt that at one period a manufacturer is apt to be assailed with difficulty in the direction named, which causes him great expense and trouble, whilst at another period he works without trouble or anxiety, and in neither case can he account for his position. I am informed positively that this seed staining comes like a veritable pestilence upon the cloth sizer and manufacturer at periods and seasons, and then may leave him again, and so on. I really think that some experiments should be made, and if the various buyers of raw cotton in this city would only place at my disposal cotton seeds from cotton of various growths and countries, I will undertake to ascertain what amounts of tannin are contained in them, and if, and to what extent, these amounts of tannin vary. Thus conditions being ascertained, remedies could be applied with more effect.

DISCUSSION.

Mr. Grimshaw suggested that cellulose had a natural affinity for these mordants, and left the China clay free from iron. With all the care that users of size might take, they would hardly be able to obtain it free from iron when they purchased it ready to put on the cloth. If they were to render the size alkaline or neutral, would it not lessen the risk of having these stains?

Dr. Burghardt could confirm the author's explanation from his own experience. A Manchester firm had sent him some cloth with black specks on it for examination, and these specks were to be seen just where the pieces of cotton-seed shells had adhered to the cloth. The cloth being full of iron—on the warp particularly—the author's explanation seemed to him conclusive.

Mr. Wm. Thomson stated that he had also examined the stains in question. He had tried to produce similar stains by means of the shell of the cotton seed upon yarns which were free from all but traces of iron. On submitting the yarn with the cotton-seed shell attached to the action of hot water, of steam, and of different sizing compositions, he had found that the stain was produced strongly in each experiment. He had, therefore, come to the conclusion that the best way of preventing the occurrence of such stains was to free the cotton perfectly from husks and shells by using the necessary machinery. The author had told them that the shell of the cotton-seed contained tannic acid, and that this combined with the iron contained originally in the yarn or in the size (probably after absorption by fibre), forming tannate of iron, to which he considered the violet stains due. The author had also pointed out that the husk of one kind of cotton plant might be more liable to produce stains than the husk of another. This was not difficult of proof, if some cotton spinner would supply the requisite varieties of husk, and he thoroughly agreed with the author in urging investigation as to the relative amounts of tannic and gallic acids, and colouring matter in the various samples.

The Chairman congratulated the author on having solved the mystery of the stains. The belief among the Chinamen that these stains resulted from incipient mildew, had been a constant source of vexation and loss to shippers for years.

Newcastle Section.

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Vice-Chairman: B. S. Proctor.

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Committee:

Alfred Allhusen.	F. S. Newall.
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G. T. France.	H. R. Procter.
C. H. Gimingham.	W. W. Proctor.
John Glover.	J. F. Stark.
John Morrison.	T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held December 9, 1885, in the College of Science.

MR. B. S. PROCTOR IN THE CHAIR.

Dr. Bedson wished to make a correction of a statement contained in his note read at the last meeting. He had there said that the gas from the Wieliczka mine consisted of marsh gas only. This was based on an analysis of the gas by Heinrich Rose. Since

then he had been able to find a much more recent analysis of the gas by Bunsen, as follows :—

Marsh Gas	84·6
Carbon Dioxide	2·58
Oxygen	2·00
Nitrogen	10·35
	99·53

The gas was obtained from that particular layer of the Wielicszka salt which decrepitates on solution in water, and he believed the sample was collected by dissolving the salt and catching the gas set free.

Mr. JOHN PATTINSON drew attention to the fact that the nitrogen and oxygen in this sample were nearly in atmospheric proportions. He said that this was very different from the Middlesborough samples analysed by Dr. Bedson, which consisted almost entirely of nitrogen. Regarding the source of this nitrogen, he referred to statements of Dr. Angus Smith in some of his reports, to the effect that nitrates in contact with organic matter are reduced to free nitrogen, the oxygen being used to burn carbon and hydrogen of the organic matter.

ON THE CONVERSION OF CALCIUM HYPOCHLORITE INTO CALCIUM CHLORATE.

BY G. LUNGE.

IN the manufacture of potassium chlorate the first step consists in passing chlorine through milk of lime. This at first produces a solution of calcium chloride and hypochlorite, which is changed into chlorate by continuing the current of chlorine at a higher temperature. It is usual to reduce this change to a simple re-arrangement of the constituents of six molecules of bleaching powder, $6CaOCl_2 = 5CaCl_2 + Ca(ClO_3)_2$; but I have already some time ago ("Manufacture of Sulphuric Acid and Alkali," vol. iii. p. 304) pointed out that the above reaction does not take place completely and without considerable loss of oxygen, except in presence of an excess of chlorine, although that chlorine does not appear in the equation. In order to acquire a more accurate knowledge of this point, the following experiments were carried out in my laboratory by Dr. Landolt :—

A. *Behaviour of Bleaching Powder Solutions when Simply Heated.*

A strong, clear, solution of bleaching powder was heated, by means of a calcium chloride bath, in a flask provided with reflux-cooler, thermometer, and siphon-tube ; the upper end of the cooler was closed by an indiarubber ball, which, when compressed, served for obtaining samples through the siphon-tube whenever required. The solution was first heated to 50° C., and was kept at that temperature for an hour before taking a sample ; it was then successively heated to 60°, 70°, 80°, and 90° C., each time for an hour, and analysed. Subsequently it was heated to its boiling point, 101° C., at which samples were taken after intervals of ½, 1, and 2 hours respectively. In the following table the results are calculated, putting the total chlorine = 100 ; column *a* shows how much of it was found as "bleaching chlorine" (*i.e.*, one molecule of hypochlorite and one of chloride), column *b* shows how much was changed into chlorate, adding to the chlorine of the chlorate itself that of 5 molecules of chloride ; column *c* shows how much further chloride had been formed by the decomposition of chlorate with loss of oxygen.

		a Bleaching Chlorine.	*b* Chlorate + 5 mols. Chloride.	*c* Chloride formed by decomposition.
Solution employed	at 15° C.	96·21	3·76	—
Heated 1 hour	,, 50	95·95	4·05	—
Another hour	,, 60	95·80	4·20	—
,, ,,	,, 70	94·41	5·10	0·49
,, ,,	,, 80	90·00	6·31	3·69
,, ,,	,, 90	83·38	11·54	5·08
,, ½ hour	,, 101	66·70	17·23	16·07
,, ½ ,,	,, 101	57·81	20·98	21·18
,, hour	,, 101	42·09	26·98	30·93

We notice that after gradually heating up to 60° for three hours no chlorate worth mentioning had been formed ; this formation only sets in after heating to 70°, and more strongly after another two hours' heating up to 90° : but even after two hours' boiling, when the heating had altogether lasted seven hours, not much over a quarter of the chlorine originally present has been employed to form chlorate.

So soon as chlorate is formed some other part of the bleach is decomposed into chloride and oxygen, and in the end this reaction takes place to a larger extent than the formation of chlorate. If we had heated for many hours, no doubt all bleaching chlorine would have vanished, but much less than half of it would have been used up for forming chlorate, more than half being destroyed with loss of oxygen. Hence it is evident that the conversion of calcium hypochlorite into chlorate by simple boiling is a very unprofitable process, which ought not to occupy the first place in the manufacturing operations.

B. *Heating a Bleach Solution saturated with Chlorine.*

The operation was carried out as in *a*, except that the liquid was first saturated with chlorine (free from hydrochloric acid), and that the expelled chlorine was allowed to escape. Since this took place but gradually, I do not tabulate the results as in the last case, but I quote the percentages of chlorine in the liquor as found ; thus, column *a* shows the bleaching chlorine of the bleach solution originally employed along with the chlorine passed into the solutions ; column *b* that employed to form chlorate (*i.e.*, six times that of the chlorate formed), *c* the sum of both of these. (See table on next page.)

Evidently saturating the solution with chlorine converts a large proportion—say seventy per cent.—of the hypochlorite into chlorate already at 15° C. ; two hours' heating to 40° increases this only slightly ; above that temperature the change takes place rather more rapidly, but quite regularly, and it is entirely accomplished at the boiling point after 7½ hours' total heating, for we now find 2·43 per cent. of chlorine as chlorate + 5 chloride, whilst we had originally altogether 2·45 per cent. of chlorine. The slight quantity of "bleaching chlorine" still found is undoubtedly mechanically dissolved chlorine, which slowly disappears by further boiling. The figures prove *that no decomposition with loss of oxygen had taken place in this case*, so that the presence of free chlorine prevents the reaction $CaOCl_2 = CaCl_2 + O$ from taking place.

C. *Heating a Bleach Solution in a Continuous Current of Chlorine.*

This was done in order to try whether under these circumstances the conversion would take place more quickly and at a lower temperature than when merely once for all saturating the liquor with chlorine. It would be of no use in this case to quote the figures for "bleaching chlorine," since continually fresh chlorine was being introduced into the liquid. I therefore merely quote the percentage of chlorine in the liquid found by analysis as chlorate + 5 molecules of chloride.

Original solution at 15° C. contained 0·12 per cent. Cl as Chlorate.
The same after passing in Chlorine at 15° C. 1·02 per cent. Cl as Chlorate.
Heated for an hour to 30° C. 1·02 per cent. Cl as Chlorate.

Another hour to	35	1·08	,,	,,	,,
,, ,, ,,	40	1·08	,,	,,	,,
,, ,, ,,	45	1·14	,,	,,	,,
,, ,, ,,	50	1·14	,,	,,	,,
,, ,, ,,	55	1·20	,,	,,	,,
,, ,, ,,	101	1·56	,,	,,	,,
,, ,, ,,	101	1·62	,,	,,	,,

Here also the current of free chlorine causes a considerable formation of chlorate even in the cold, and this increases but slowly when gradually heating up, *in spite of continually passing in more chlorine*, certainly not any more than in the preceding series of experiments, where only in the beginning an excess of chlorine had been provided. Whilst in the former series after nine hours the quantity of chlorate was twenty-seven times that originally present, in the second series this amounted to only 12½ times. It is not impossible that the continued current of chlorine carried away some of the hypochlorous acid liberated in the process, and thus diminished the formation of chlorate.

In any case the continued passing of chlorine through the liquid is useless, perhaps even injurious; it is sufficient if always a slight excess of chlorine is present.

We understand this fact quite well from a theoretical point of view, since none of the free chlorine is used up in the reaction. Hitherto no other explanation of that reaction has been given but that mentioned in the above-quoted place (vol. ii. p. 890)—namely, that first of all, the action of an excess of chlorine on the hypochlorite leads to the formation of free hypochlorous acid (a well-known fact), and that the latter converts another quantity of hypochlorite into chlorate. The following equations seem to represent these reactions in the most probable way:—

(1) $Ca(OCl)_2 + 4Cl + 2H_2O = CaCl_2 + 4HOCl$.

(2) $2Ca(OCl)_2 + 4HOCl = CaCl_2 + Ca(ClO_3)_2 + 4Cl + 2H_2O$.

That is to say, the free chlorine only serves as carrier of the oxygen of two molecules of calcium hypochlorite to a third molecule of the same, whereby the two former molecules are reduced to chloride, the third molecule is oxidised to chlorate, and the free chlorine first entering into the process is again completely liberated in the end.

D. *Conversion of Hypochlorite into Chlorate at the Ordinary Temperature.*

In the first stages of the series B and C we had noticed that a considerable quantity of chlorate was formed by merely passing chlorine into a solution of bleaching powder at the ordinary temperature. In B this amounted to seventy per cent. of the theoretically possible quantity. This suggested the experiment of trying whether the conversion might be made perfect by simply prolonging the contact with chlorine at the ordinary temperature for some length of time.

A bleach solution containing 1·75 per cent. bleaching chlorine and 0·12 per cent. of chlorate-chlorine (*i.e.*, chlorine belonging to chlorate + molecules of chloride) was saturated with free chlorine and allowed to stand at 15°. It showed—

After 24 hours 1·26 per cent. Chlorine as Chlorate + 5 Chloride.
,, 48 ,, 1·32 ,, ,, ,, ,,

The last figure, deducting the original 0·12, amounts to 1·20—that is, sixty-nine per cent. of the quantity theoretically obtainable from the hypochlorite present. This shows that the conversion at the ordinary temperature proceeds almost at once to the limit of about seventy per cent., but afterwards makes very slow progress, so that it is impracticable to wait for its completion without heating.

The above-described experiments seem to point to the following conclusions:—The most favourable way of converting hypochlorite into chlorate is not either a mere raising of the temperature, or a mere excess of chlorine, by themselves, but both these conditions must be fulfilled at the same time. A *large* excess of chlorine is useless, perhaps injurious, for the yield of chlora On the large scale it is

		a Bleaching Chlorine.	b Chlorate + 5 Chloride	c Sum Total.
Original solution at	15° C.	2·36	0·09	2·45
The same saturated with Chlorine at	15	1·85	1·78	3·63
Heated one hour to	30	1·78	1·78	3·56
Another hour to	40	1·68	1·83	3·51
,, ,, ,,	55	1·47	1·94	3·41
,, ,, ,,	60	1·26	2·01	3·27
,, ,, ,,	70	0·98	2·13	3·11
,, ,, ,,	80	0·72	2·23	2·95
,, ,, ,,	90	0·42	2·35	2·77
,, half-hour to	101	0·17	2·43	2·60
,, ,, ,,	101	0·11	2·48	2·59
,, hour ,,	101	0·07	2·49	2·56

unnecessary to raise the temperature artificially, the heat produced by the reaction itself being sufficient to complete it. A rise of the temperature without the presence of free chlorine is most injurious, because then a great deal of hypochlorite is split up into chloride and oxygen; an excess of chlorine prevents this loss.

ON THE ESTIMATION OF SULPHUR IN PYRITES.

BY G. LUNGE.

I SHOULD not feel called upon to say a last word in reply to Dr. Clark, if his last communication (*Journal of the Society of Chemical Industry*, 1885, p. 573) did not mix up several things which ought to be separated, thus producing an erroneous impression with respect to my process for estimating sulphur in pyrites. He now states that the dry process (his own process is but a slight modification of others previously known; compare, for instance, Lunge and Hurter's "Alkali Makers' Pocket Book," p. 114) was experimentally compared with only that modification of the wet process used by the Tharsis chemists and Dr. Tatlock. But in his first communication, which I opposed, he speaks at length of my wet process, without saying that the "ordinary wet method," by which the analyses quoted by him were made, essentially differed from mine. To that Glasgow method, as now described by him, but to which I cannot concede the title of the "ordinary" wet method, I should certainly demur on account of the large excess of acid employed. It is not that method, it is *mine*, as described in the above Pocket Book, p. 81, of which I stated, on unimpeachable authority, that it yielded most satisfactory results, and had, in Germany, put an end to disputes between buyers and sellers. The discrepancies of half per cent., mentioned by Dr. Clark, had occurred to Fresenius' assistants with my *old* process (that is, that described in my "Sulphuric Acid and Alkali," vol. i. p. 102); and although experimenters accustomed to the process (assuredly an indispensable condition for obtaining perfect trustworthiness with any analytical process, but one not fulfilled by those gentlemen) would have obtained far more satisfactory results, I was induced to modify my process in such a way that it has been found acceptable to Dr. Fresenius himself, and to the German chemists generally. This process yields the sulphur of pyrites with an accuracy entirely sufficient for all practical purposes (the *maximum* of discrepancies not exceeding ¼ per cent.); and it purposely leaves aside the sulphur of galena, and that combined or combinable with baryta or lime, which in some descriptions of pyrites amounts to several per cent., all of which are absolutely useless for the manufacture of sulphuric acid.

DISCUSSION.

Mr. RENNOLDSON mentioned that he had that afternoon made an experiment which agreed generally in its results with Dr. Lunge's experiments in series A. Taking a solution of bleaching powder, and boiling it until of the usual concentration for the preparation of chlorate (sp. gr. of 1·3 to 1·4), he found that, while the total chlorine was the same as before, only about 20 per cent. of the original bleaching chlorine remained as such, about 40 per cent. was converted into what Dr. Lunge has called "chlorate-chlorine," and hence oxygen must have been given off equivalent to the remaining 40 per cent. He had been surprised at this result, for though he was aware that certain reagents would evolve from bleach oxygen equivalent to its bleaching chlorine, he had not expected that it would decompose in that way of itself.

The SECRETARY mentioned a case which had occurred of a bottle of bleaching powder, which had been standing aside for several months, and had suddenly burst. The total chlorine was found to be the same as in the fresh bleach, and the only explanation which could be offered was that the bleach had gradually decomposed with evolution of oxygen, which had accumulated until its pressure sufficed to burst the bottle.

Mr. JOHN PATTINSON, in regard to the second paper by Dr. Lunge, wished to state that he had made com parative analyses of a sample of pyrites by Dr Clarke's method and by Dr. Lunge's method (the "new" method as described in Lunge & Hurter's Pocket Book), with the following results:—

	Clarke's Method.	Lunge's Method.
(I.)	48·97	48·88
(II.)	48·80	48·80

It appeared, therefore, that the two methods gave practically identical results, and that Dr. Clarke's contention that his method gave higher percentages than Dr. Lunge's could scarcely be upheld.

Glasgow and West of Scotland Section.

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G. G. Henderson, Chemical Laboratory, University of Glasgow.

January 5, 1886.—Mr. D. Clerk—"On the Specific Heats of Gases at High Temperatures."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Second Meeting of the Third Session of this Section was held in the Rooms, 207, Bath Street, on Tuesday, 1st December, 1885.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

ON THE REFUSE WATERS OF CHEMICAL WORKS AND OTHER FACTORIES.

BY DR. WALLACE, F.R.S.E., F.I.C., F.C.S.

DURING last Session considerable interest was excited in this Society by the announcement that a new Rivers Pollution Bill had been introduced into the House of Commons, some of the provisions of which were considered so stringent that manufacturers would have much difficulty in complying with them. The subject was discussed in considerable detail in London and at the sectional meetings throughout the country. At the meeting held here on 3rd February last, the greater part of the evening was spent in the criticism of the Bill by several authorities on the subject of River Pollution. Among others I took part in the discussion, and, going over the Bill clause by clause, endeavoured to show that while in some cases the proposed enactments were unnecessarily

stringent, in others they were decidedly too lax. I mentioned that I was at the time engaged in a series of analyses of refuse matters from chemical and other factories. These were shortly afterwards completed, and the results reported to the Town Council of this city on 30th April. The analyses amount to 47, and include 2 of town sewage, 12 effluents from dyeworks, 4 from distilleries, 2 from paper works, 2 from tar and ammonia distilleries, 2 from gut works, 4 from slaughter-houses, 2 from tanneries, 4 from skin-dressing, dyeing, and tanning works, 3 from oil refineries, 1 from a soapwork, 6 from chemical works, 1 from a brewery, and 2 from galvanising works.

I propose to-night to state, in general terms, the nature of the results obtained in this inquiry, and to make some observations on the probable effects of manufacturing refuse waters in the purity of rivers.

Of the 45 samples of refuse water (the other two being ordinary sewage) 14 had an alkaline reaction, 18 were acid, and 13 were neutral. The highest degree of alkalinity was that of a refuse water from a soap factory, which contained alkali equal to 958 grains of real soda per gallon. The largest quantity of free acid was found in a refuse water from a galvanising works, the acidity being equal to 5432 grains of oil of vitriol per gallon. The quantities of the liquids containing these enormous proportions of alkali and acid are, fortunately, comparatively small; but other samples containing considerable quantities represented large daily outflows.

A number of the liquids contained dissolved matter which was capable of being precipitated by neutralising. Thus the waste water from galvanising works contained in solution enormous quantities of iron and zinc, with small proportions of arsenic; and a liquid from a chemical work contained the following:—

	Grains per gallon.
Sulphuric anhydride	7457·5
Chlorine	4914·0
Iron	2177·7
Copper	52·4
Zinc	525·5

Such liquids as these will give a large amount of precipitate on being neutralised, as no doubt they will be, by mixing in the sewers or in the river with sewage and with alkaline waste waters. Again, in water discharged from distilleries, even if free from sediment, there is a large amount of gluten dissolved in lactic acid, and this gluten will precipitate if the liquid is neutralised.

Many of the liquids contain putrescible ingredients, and become very noxious by keeping for some time. Among these are the drainage from the slaughter-houses and the effluents from gut works, tanneries, and skin-dressing and dyeing works, paper works, and distilleries.

Some of the liquids evolve sulphuretted hydrogen on being neutralised. The water from heaps of soda waste are pre-eminent in this respect. One of the specimens examined was found to have a degree of alkalinity equal to 753 grains of real soda per gallon. It had a deep yellow colour, and contained sulphides of sodium and calcium, and also some sulphites and hyposulphites. The amount of sulphur in the sulphides was 913 grains per gallon, and 238 grains of sulphur were precipitated on the addition of an acid. The liquid also contains a small proportion of arsenic in the form of sulphide.

The proportion of solid or suspended matter in the discharges is very important, since these are liable to settle down in the bed of a river and produce a pestiferous mud constantly evolving offensive gases. The worst offenders in this respect are the distillers, but dyers, tanners, paper-makers, skin-dressers, and others, are also to be credited with the admission to the sewers, and hence to the river, of a great amount of solid matter which should not, in my opinion, be permitted to leave the various works.

In 1879 I was engaged in the prosecution of a series of experiments on the chemical and mechanical treatment of sewage, for which works were established near the outlet of one of the city sewers; but unluckily for me this sewer contained the drainage of two distilleries. At the beginning of the experiments the sewage was so much contaminated with pot-ale that it contained on one occasion 66 grains per gallon of free acid (calculated as acetic acid), and on two other occasions nearly as much. The effect was that the sewage, besides being rendered acid, was enormously increased in strength as regards nitrogenous organic matter, and that instead of 1 ton of lime per million gallons being amply sufficient for precipitation, from 33 cwt. to 2 tons were required. In most distilleries it is now the practice to add a limited quantity of lime, which neutralises a portion of the acid, and to collect as much of the suspended organic matter as can be conveniently got, press it in bags, and sell it for feeding pigs. The effluent water still contains much acid and dissolved albumenoids, and is quite unfit to be run into a sewer. It should be treated with a slight excess of lime and thoroughly settled or passed through a filter-press, and the solid produce disposed of as manure. In one lot of dried sludge made from sewage largely charged with pot-ale, the calculated manurial value was £4 9s. per ton; while the dry sludge made from the same sewage when free from that contamination, by the same process, had a calculated value of only £1 8s. 4d. per ton. In the treatment of pot-ale, a mixture of sulphate of alumina and lime causes a more rapid precipitation than lime alone, but does not present any other advantage.

There are several objections to the admission of pot-ale into sewers and into rivers. Its acidity alone is objectionable, on account of its corrosive action upon all descriptions of mortars and cements, which it gradually eats away, destroying the stability of built sewers and the jointing of pipe-drains, and permitting the sewage to get away into the subsoil. Again, if the acid liquid comes in contact with sewage which, from continued dry and warm weather or other circumstances, has become to some extent decomposed with the formation of sulphides, it will set free sulphuretted hydrogen. A case occurred a few years ago in this city, in which a copious volume of sulphuretted hydrogen was evolved and very serious inconvenience caused. Two sewers in contiguous and parallel streets conveyed to the river highly acid water, and water charged with alkaline sulphides. So long as the sewers remained tight no harm was done, at least till the foul liquids reached the river; but in course of time the acid water ate its way through its own sewer and into that containing the sulphides, and such a stench was created that the city authorities were obliged to lift and relay both sewers. Another objection to pot-ale is that it is itself highly susceptible to putrefactive changes, and in its worst form is at least 17 times the strength of average Glasgow sewage, which contains 5 grains per gallon of free and producible ammonia. The sedimentary matter existing in the pot-ale, or produced by the neutralising of its free acid, settles down very readily in the beds of rivers, wherever these are sluggish in their flow, giving rise to a peculiarly noxious soft mud which, in warm weather, stinks badly, and is generally teeming with the small red sewage worm *tubifex rivulorum*. I have seen this mud in a great many rivers receiving the discharge from distilleries. Pot-ale should not therefore be allowed to pass into

a river, even in cases where a special pipe is provided to deliver it. The addition of lime in slight excess neutralises the free acid and throws down a large proportion of the dissolved, as well as the whole of the suspended, impurities. After this treatment the clear effluent may be allowed to pass into a sewer or into a river without risk of creating a nuisance.

In regard to acid discharges generally, I am of opinion that it will in most cases be found sufficient to run the waste water over a slightly inclined bed of chalk or limestone of sufficient extent. This is done at one large chemical works in Glasgow (the acid being chiefly hydrochloric), and the results are quite satisfactory, the free acid in the effluent being only about half-a-grain per gallon.

In paper mills there are, from different parts of the process, both alkaline and acid waste water. If the whole drainage be brought into one series of settling tanks, sufficient to contain each the product of a day's working, and thoroughly mixed, such an amount of neutralisation and purification will be effected that the effluent may safely be turned into a sewer or direct into a river. The probability is, that in almost all paper mills, where the drainage is treated in this way, the final effluent will be alkaline rather than acid. Of course I assume that the "black boil" or strong alkaline liquor drained off from the cylinders in which esparto grass is boiled with caustic soda, is treated separately, and the soda recovered by evaporation and incineration. In cases where this is not done, it is hopeless to attempt to make the effluent sufficiently pure to be admissible to a river.

I have already referred to the effluent from galvanising works, and from a particular chemical work in this city, as containing an enormous amount of iron. It is chiefly in the form of protochloride, and is accompanied by a large quantity of free acid. This liquid must have a very deleterious effect on built sewers and the jointings of pipe-drains, and should not, on any account, be allowed to pass into them. The simplest method of purifying it would be to add lime in sufficient quantity to neutralise the free acid, and precipitate the oxide of iron which, after exposure to the air to convert it into peroxide, could be washed and dried, forming an ochre which could be readily disposed of to paper makers, paper stainers, linoleum manufacturers, and pigment makers, and would probably more than repay the cost of production. It would also be an excellent material for the purification of illuminating gas. The liquid would require to be considerably diluted before precipitating, and the mixture with lime exposed for some time in shallow tanks or ponds to promote oxidation. This liquid would be, in conjunction with alum-cake and lime, a most valuable agent for the precipitation of town sewage. It has been found in Coventry and some other English towns, that the addition of an iron salt, such as exists in this liquor, to the ingredients formerly used (alum-cake and lime), gives a superior effluent, with less expenditure of precipitants, to that formerly produced. Dr. Thresh, of Buxton, has recently found that a mine water containing some iron salt, when mixed in considerable quantity with sewage, causes a rapid precipitation, and gives a clear and excellent effluent. The strength of the waste liquid is such that it would bear railway carriage to any precipitation works within a distance of twenty miles, or even more; and it might be conveyed in tank waggons lined with lead, or well coated with pitch.

When waste water of this kind is run into a river, the acids are neutralised by the calcic and magnesian carbonates of the river water, and an ochrey precipitate is formed, which is most injurious to fish. Certain kinds of pit water are of a similar character, although not nearly so concentrated; and the effect of such admixture is seen in many of our Scotch rivers, especially the Almond and its tributary the Breich Burn, from which fish, formerly plentiful, have practically disappeared.

Few manufacturing operations are more destructive to the purity of rivers than the washing of skins and hides. The effects are seen on the Molindinar Burn in Glasgow, and in the Gala at Galashiels.

When the "yellow liquor," drained off heaps of soda waste, is introduced into a river, the sulphides are gradually oxidised by the free oxygen dissolved in the water, and the greater part of the sulphur is set free in a finely divided condition, rendering the water milky. If present in large proportion, however, a portion of sulphuretted hydrogen will be set free by the action of carbonic acid, and a noxious odour will be evolved. In the case of our own river Clyde, the mud which settles down in certain places, contains always a notable proportion of sulphide of iron, the sulphur of which, or part of it, is probably derived from the yellow liquor which comes down a special pipe from the northern part of the city. I have already referred to the evil arising from an admixture of acid water *in the sewers* with the yellow liquor; sulphuretted hydrogen is given off in quantity, and a very serious nuisance results. When the yellow liquor is sufficiently strong it can be treated successfully for the production of sulphur. By blowing air through it a good deal of sulphite and hyposulphite are produced, and by oxidising one portion and adding another in its ordinary condition, and neutralising with hydrochloric acid, nearly the whole of the sulphur is precipitated.

In the case of Glasgow, the quantity of manufacturing refuse water is nearly nine million gallons per day, and on the average of the various samples it is about three times as strong in putrescible organic matter as ordinary town sewage. But some of the discharges that are largest in quantity are comparatively clean, so that the average of the whole nine million gallons of manufacturing waste water is considerably less than three times as strong as the twenty-seven million gallons of ordinary sewage. On the other hand, there are a number of small factories in the city which, collectively, give a considerable volume of refuse water; and there are several works beyond the city boundaries which give discharges of a most objectionable character. Upon the whole, I consider it a fair estimate to assume that the impurities found in the water of the Clyde are due to sewage proper, and to manufacturing refuse, in about equal proportions. Many of the factory discharges contain large quantities of suspended matter, and are otherwise comparatively free from impurities. In such cases, all the purification that is necessary to render the effluent admissible into the public sewers, or into the river, is the adoption of a thorough system of subsidence, aided, when required, by the addition of chemicals, as in the precipitation of ordinary sewage.

It may be well, here, to refer to legislation for the prevention of the pollution of rivers, so far as it refers to manufacturing waste products. The Act at present in force is that of 1876. The provisions in that Act are very indefinite, and are hedged about with so many conditions, that they have been found to be practically inoperative. Stated generally, the Act forbids the putting into any stream, any poisonous, noxious, or polluting liquid proceeding from any factory or manufacturing process, unless it can be shown that the best practicable and reasonably available means have been used to render harmless the poisonous, noxious, or polluting liquid. Proceedings, however, can be instituted only by a Sanitary Authority, with consent of the Local Government

Board (in Scotland, the Secretary of State). It is further provided that the Local Government Board (or Secretary for Scotland) shall not give their consent to proceedings by the sanitary authority of any district which is the seat of any manufacturing industry, unless they are satisfied, after due inquiry, that means for rendering harmless the poisonous, noxious, or polluting liquids proceeding from the processes of such manufactures are reasonably practicable and available under all the circumstances of the case, and that no material injury will be inflicted by such proceedings on the interests of such industry.

A very important section of the Act is No. 7: "Every sanitary or other local authority shall give facilities for enabling manufacturers within their district to carry the liquids proceeding from their factories or manufacturing processes into such sewers: Provided they shall not extend to compel any sanitary or other local authority to admit into their sewers any liquid which would prejudicially affect such sewers, or the disposal by sale, application to land, or otherwise, of the sewage matter conveyed along such sewers, or which would, from its temperature or otherwise, be injurious in a sanitary point of view: Provided also that no sanitary authority shall be required to give such facilities as aforesaid, where the sewers of such authority are only sufficient for the requirements of their district, nor where such facilities would interfere with any order of any court of competent jurisdiction respecting the sewage of such authority."

Under the existing law, therefore, and under existing circumstances, the corporation of a city or town are bound to admit into the sewers all manufacturing waste water, unless—

1st. The waste liquid would act injuriously upon the sewers. This effectually enables them to forbid the putting into the sewers of any liquid containing free acid.

2nd. Unless from its temperature or otherwise it would be injurious in a sanitary point of view. This enables the authority to exclude from the sewers such liquids as the yellow liquor from soda waste, and probably also such foul liquids as

Distillery waste water (pot-ale).
Papermakers' discharges.
Gut-work discharges.
Galvanising-work discharges.

unless these are effectually purified by neutralising and settling, or filtration.

With regard to the Rivers Pollution Bill brought in by Mr. Hastings, Earl Percy, and Colonel Walrond, in last Session of Parliament, and which will probably be re-introduced in a modified form in the coming Session—I may say generally, after a careful study of the "standards of purity," and the analysis of the waste waters of the Glasgow factories, that only one of the whole 45 effluents would comply with these standards, and would be admissible into the city sewers or into a river. As an illustration of the stringency of some of the clauses, I may mention that one of the standards of purity is, that no liquid shall be permitted to enter a stream which contains more than seven-tenths of a grain per gallon of sulphur, in the condition either of sulphuretted hydrogen or of a soluble sulphuret. Now, one of my samples contained upwards of 900 grains per gallon in this condition; and it follows that it would not have been admissible to the Clyde, under the proposed Bill, even if mixed with a thousand times its bulk of clean water.

In regard to the general question of the pollution of rivers, whether by manufacturing refuse or by the sewage of towns and cities, there are three considerations: (1) the effect on the suitability of the water for dietetic purposes, the watering of cattle, the washing of clothes, and other primary uses, as they are called in Scotland; (2) the effect upon fish, generally, and especially upon salmon; and (3) the effect upon the amenity of a river or its banks. Many rivers receive a great amount of impurity both from manufacturing and domestic sources, and yet cannot be described as polluted streams. Take, for example, the river Tay, which receives the whole of the sewage of Perth, a city of about 30,000 inhabitants, besides the drainage from several very extensive dyeing establishments. But this river, one of the largest, if not the largest, in the British Isles, carries such a volume of water that the impurities are swallowed up and oxidised almost immediately, and the amenity of the river is not appreciably injured. As regards fish, salmon are caught in great numbers, one of the most valuable of the fishing stations being right in the middle of the city of Perth. For drinking and other primary purposes, however, the water is appreciably deteriorated for at least a mile below the town, and hence it is proposed to purify the sewage and effluents from the dyeworks before admitting them to the river. As an example of what may be called the self-purification of a river, the Thames is a good example. It receives in its course the sewage of many towns and villages, some of them of considerable size; and yet, above London, it is so far purified that simple mechanical filtration converts it into potable water of very good quality. The condition of the Clyde above Glasgow is also fairly satisfactory, considering that it has received the drainage of the towns of Lanark, Hamilton, Airdrie, and Coatbridge, besides others of smaller dimensions; but below the city it is extremely dirty; it is totally unfit for primary purposes, fish cannot live in it, and it cannot be sailed upon without risk of causing nausea, if nothing worse. The condition of the Clyde, however, bad as it is, is not to be compared with that of the Irwell, the Bradford Beck, the Aire, and some other rivers in the manufacturing districts of England, which are little better than open sewers.

That something should be done to improve these rivers is readily admitted by all, but hitherto the difficulties of dealing with them have been so great that practically there is little improvement in their condition. It is true that some towns, such as Birmingham, Coventry, Leeds, Bradford and Leicester, have been compelled to erect works for the purification of their sewage, but in some cases the effluent falls into a river so impure that no appreciable improvement is produced. A new Act which will compel all towns above a certain size and all factories draining direct into a river to effect such a purification as is necessary, is urgently needed; but the standards of purity need not be so stringent as some of those contained in the Bill introduced in last Session of Parliament. If all suspended matter be effectually removed by mechanical or other means, poisonous substances excluded, and free acid or alkali, as the case may be, reduced to reasonable limits, that is really all that is necessary. The dissolved oxygen in the river water, aided by the microscopic organisms which are rarely, if ever, absent, will complete the purification, except in a few extreme cases where the volume of the river or stream is small as compared with that of the drainage. In the case of Glasgow sewage, I have demonstrated that when deprived by any means, mechanical or chemical, of its suspended impurities, and afterwards mixed with ten times its bulk of clean river water, it will no longer putrefy, but on the contrary will speedily become, to all intents and purposes, pure water.

DISCUSSION.

Prof. Mills thanked the author for his suggestive paper, and acknowledged that he had shown great

resource in treating effluents from works. The chemical side of the problem presented little difficulty, but manufacturers had also to consider the question of space for tanks and filtering operations. With the prospect before them in the near future of the passage of some stringent measure to prevent pollution, he would advise them to look to their surroundings and see if they could acquire land for such purposes. Some years back, Dr. Angus Smith had found decided self-purification in a canal of very sluggish current; and the river Thames showed considerable chemical purification at various points of its course. This was attributed to filtration of a portion of the flow through porous soil, the water reappearing in a clarified state—farther down stream. On the other hand, during the last two years of his life, Dr. Angus Smith had instituted physiological experiments to determine the presence of germs in river water. By the use of the gelatin process he had discovered swarms of organisms in that supplied to London, and had reported to this effect to the Local Government Board, giving drawings to illustrate his results. Until this apparent conflict of opinion had been reconciled, and experiments like those of Dr. Angus Smith were instituted on a larger and more comprehensive scale, he felt that scientific men would do well to suspend their judgment. Meanwhile he would invite the attention of physiologists and sanitary authorities to this question of physiological purification, which might be far harder to achieve than mere chemical purification.

Mr. Coleman said that Dr. Dupré had recently addressed a report to one of the Metropolitan boards, which had been published, showing that the amount of bacterial life in rivers such as the Thames was best determined in the following way: A measured quantity of the water was confined in a glass vessel over air or oxygen, and after several days a determination was made of the amount of oxygen absorbed and converted into carbonic acid. Dr. Dupré considered this method better than estimating organic matter by permanganate of potash or any such process which arrested bacterial life—the essence of an examination being held to be the observation of the vitality of the germs which, according to their several natures, might be pestiferous or beneficent. If he remembered aright, it was also pointed out how the different kinds of germs might be approximately distinguished one from another. The *Engineer* of 27th November contained an able comment upon this report.

Mr. Tatlock said that the paper showed in a striking light what care must needs be exercised in drafting any measure for the prevention of river pollution, and how completely the latest attempt in this direction had failed. All waste waters and discharges from chemical factories and other sources were placed on the same footing, and were to be compared with one fixed standard of organic and inorganic purity—a perfectly impracticable matter, as anyone acquainted with the variety and nature of these discharges very well knew. Purification would be dearly purchased if it involved closing works and ruining industries. He thought that in future legislation it would be best to treat all classes of works, each upon its own merits, and appoint inspectors with large discretionary powers. In his opinion legislation should follow science, and not precede it by seeking to enforce processes of purification which were at present unknown.

Mr. Stanford asked whether he was right in his opinion that Dr. Dupré did claim to distinguish so-called pestiferous germs from harmless ones, and also whether boiling failed to destroy sewage germs while killing innocuous varieties. If that were so, a means was now afforded for the first time of finding whether organic matter in water was dangerous or not, and this had long been a desideratum. As regarded the paper before them, he had been astonished to hear how concentrated some of the effluents from the Glasgow factories were. The idea of a liquid containing per gallon ¾lb. of oil of vitriol being sent into the sewers was indeed alarming. No public authority could deal with such pollution as that, and all such must be imperatively checked at its source and dealt with there. Dr. Wallace appeared still to think lime the best available purifying agent. Was it not the case that the effluent from lime purification was nearly always alkaline and liable to putrefaction. In his opinion the only method capable of dealing with soluble organic impurity was to filter it through a bed of charcoal, preferably wood charcoal, and constantly revivify the filtering medium by turning. This was neither an expensive nor difficult method, provided that all matter in suspension were previously removed.

Dr. Wallace, in reply to Prof. Mills, said that space was an important factor in chemical operations. In cases where no space was to be had upon the spot, as in many Glasgow factories, he would suggest running the foul liquids by a special pipe to a distance for treatment. As to Dr. Angus Smith's experiments on the London waters, he was well aware that a certain measure of self-purification did not entirely preclude the presence of germ life. Within the last few days he had seen results obtained by Dr. Percy Frankland upon that very water supply, showing that they contained germs in variable and sometimes considerable quantity. At the same time, such waters might be quite suitable for primary purposes, and serve well enough to sustain fish life. Dissolved oxygen acted not only on impurities introduced by man, but also on those derived from the soil. For instance, fresh Loch Katrine water contained only traces of carbonic acid, the dissolved gases consisting almost entirely of oxygen and nitrogen. After the lapse of a few weeks the water, if kept in a jar, evolves, when boiled, gases containing about 5 per cent. of carbonic acid, which showed that the oxygen of the air had been acting upon the natural impurities contained in the water. In reply to Mr. Tatlock, the absurdity of putting all rivers and localities under the same conditions had been sufficiently demonstrated in their previous discussion on the subject. He knew many instances in which the so-called pollution was purer than the stream which it was supposed to contaminate. In respect to the action of lime he quite agreed with Mr. Stanford. Free lime was poisonous to fish and liable to cause putrefaction. At Bradford the alkaline effluent from the sewage works was passed through a bed of fine breeze, which promoted precipitation in its pores of the lime in the form of carbonate, leaving the effluent nearly neutral. A slight addition of acid would serve to complete the action. Wood or seaweed charcoal would do even better than breeze for this purpose, but breeze was practically a waste product and readily obtainable in large quantities in most localities, whereas wood and seaweed charcoal were not.

(A) ON THE USE OF IRON INSTEAD OF ZINC FOR THE CONSTRUCTION OF VOLTAIC BATTERIES. *(B)* ON THE WASTE OF ENERGY IN PRECIPITATING COPPER SALTS BY METALLIC IRON, AS COMMONLY PRACTISED.

BY J. J. COLEMAN, F.I.C., F.C.S.

It seems very singular to me that more attention has not been bestowed upon the utilisation of iron as a

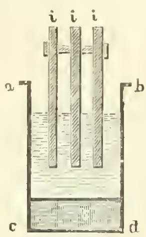
substance to be burned in a voltaic battery, seeing that the oxidation of iron, according to the researches of Andrews and Favre and Silberman, develops two-thirds or three-fourths as much heat, weight for weight, as zinc. The exact figures are these—677 as against 847, supposing the iron is used to precipitate copper sulphate solution instead of zinc. Iron has been frequently used as the electro-negative element of a battery, especially when in the passive state by contact with concentrated nitric acid. Probably the objection to its use as an electro-positive element has arisen from the earlier experimenters finding local action uncontrollable, which in the case of zinc could be obviated by the expedient of amalgamation. I have recently made some experiments in this direction. In point of fact, I have constructed a sulphate of copper cell in which the copper is used in contact with sulphate of copper, as is customary in Daniell's cell, but the zinc is replaced with iron used in contact with ferrous sulphate. I find that three of such cells connected in series decompose water, so that the electromotive force is probably what theory indicates, about two-thirds of a Daniell cell. Moreover, such a form of battery gives what the practical chemist dearly loves—viz., a chemical cycle easily worked, and restoring the materials to their original state. The solution of sulphate of iron produced by the working of the battery on evaporation and distillation yields sulphuric acid and peroxide of iron, the former ready to be combined again with the deposited copper, and the latter ready for the blast furnace to be reconverted into metallic iron. For the prevention of local actions, I find that a form of battery similar to the Medinger or Sir William Thomson battery answers, with some important practical alterations of detail, and this battery, requiring no porous cells, can be made of any size desirable.

After the iron plates *i i i* were placed in position, and the 12 cells were connected in series, the surface of the iron solution was protected from the oxidising influence of the atmosphere by a layer of oil, and the whole was allowed to remain at rest, with the exception that as the sulphate of copper became exhausted a little fresh saturated solution of sulphate copper* was poured down the funnel *f*, and a corresponding quantity of sulphate of iron solution was drawn off at the point *x*. It was found that cast-iron plates were very unevenly acted upon; they became friable and spongy, and resembled in appearance cast iron which has been immersed for a number of years in sea-water. Malleable iron plates were more satisfactory, and were easily cleaned, after being in use for a period of three months.

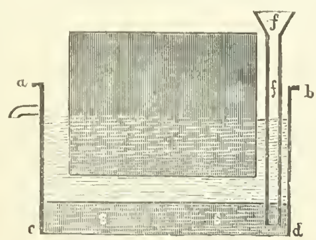
Mr. Bottomley has been kind enough to test one of the cells in Sir W. Thomson's laboratory, and has found the E.M.F. to be ·56 of a Daniell cell. Possibly better results may be obtained, and for this reason a few more tests will be made with a few cells connected in series. Meantime it has been noted that with about 100 square inches of surface of the copper plate, the *electrolytic* deposition of copper in each cell amounts to about 1oz. avoirdupois in 24 hours, the electrodes being connected with thick wire.

Although the E.M.F. of this battery is small, the cheapness of the materials, and facility with which they may be obtained and restored to their pristine state in unlimited quantity, makes it worthy of some notice. There is no doubt that any method of constructing a primary battery which involves selling of a product likely to glut the markets is of little national importance, but any effort to utilise a material like iron, even although the action may be slow, or the apparatus cumbersome, is worthy of attention.

From these experiments it would appear that in



End Elevation.



Side Elevation.

The foregoing words formed a portion of a recent address to the Philosophical Society of Glasgow, but since then I have had occasion to construct a constant battery for working a Ruhmkorff induction coil, employed for a lengthened series of experiments upon ozone during the months of June, July, and August of this year. The battery was constructed of twelve cells, having the following form, and worked remarkably steady for the whole period of three months, as evidenced by the length of the spark of the induction coil, which was sometimes worked for thirty hours consecutively :—*a b c d* is a copper cell, *i i i* are iron plates dipping into solution of ferrous sulphate dissolved in four parts of water. *s s s* is a layer of saturated solution of copper sulphate introduced by the funnel *f f f*, having a wide stem so as to prevent hydrostatic pressure causing current in the ferrous solution.

When the cell was thus prepared it was found that the layer of sulphate of copper solution remained without much diffusion into the sulphate of iron solution for two months.

practice the consumption of iron in a primary battery would be at least 50 per cent. more than that of zinc for equal strengths of current, but on the other hand, malleable iron is only half the price of zinc, and cast iron is only one fourth its price. Primary batteries will always be more or less in demand, and when well constructed, I am inclined to think yield currents at as little cost as those produced by the dynamo, except in those cases where the motive power is at hand. Anybody with the slightest experience with machinery knows that the cost of erection, attendance, and repairs is a very serious undertaking, supposing an engine has to be run a great number of hours daily. Any extensive use of zinc, on the other hand, would soon affect its market price, as the annual consumption of the metal throughout the world does not exceed 70,000 tons. Taking into consideration the illuminating power of the 15 million thousand cubic feet of gas produced in London, I find that to produce the same amount of light by electricity 350,000 tons of zinc

* Care must be taken that the sulphate copper solution is absolutely saturated with the salt.

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would have to be oxidised per annum in a primary battery. If iron were used the amount would be about 600,000 tons per annum, which is less than 10 per cent. of the annual production of iron in Great Britain (now amounting to say 7,000,000 tons per annum, the production of iron in the whole world being about 14,000,000 tons per annum). If sulphate copper be used in a primary battery it is not necessary to consider the annual production of the metal, as it could be almost entirely recoverable, giving reduced copper of the same character as is at present produced to the extent of 14,000 tons per annum in Great Britain, by the wet processes of Henderson and others.

It is also obvious that the hydrochloric acid solution of copper produced by the Henderson process, yields when precipitated by iron a vast amount of energy which is at present wasted in the form of heat. By a suitable arrangement of precipitate vats this energy may be utilised in the form of an electric current. If it could be all utilised, the precipitate of 14,000 tons of copper per annum would yield electricity sufficient to work 60,000 Swan or Edison electric lamps, but owing to the distance of many of the works from large centres of population, only a small portion of the waste energy can be utilised.

Mr. Coleman exhibited twelve cells in working order, and in answer to questions, said :—The iron plates are immersed in the solution of ferrous sulphate only, and do not dip into the solution of cupric sulphate, hanging about 3in. above its level. The latter solution is always in a state of saturation, for as metallic copper is precipitated the sulphuric acid liberated combines with the iron of the plates. The cupric sulphate solution is replenished from time to time through a funnel tube passing nearly to the bottom of the cell. The cells should be square, as with such a form, the iron plates can be increased in number.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held November 12th.

ON THE TREATMENT OF PYROLIGNEOUS DISTILLATE.

BY THOMAS MORGAN, M.I.M.E.

University College, Bristol.

In the issue of this Society's Journal for May last, there appears, at page 19, an interesting and instructive paper by Mr. C. A. Fawsitt on "Wood Naphtha," the said paper referring to, among other things, the plant suitable for producing crude pyroligneous liquors, and the method followed in West Scotland for deriving miscible wood spirit from them.

There is, in the aggregate, an extensive business in wood distilling carried on in the West of England and South Wales, and upon this ground I decided to attempt to follow Mr. Fawsitt's good example, and to supplement his paper by bringing before the notice of our new section of the Society an account of the methods generally adopted in this district for dealing with pyroligneous distillate, including also some particulars of the application at one place of a simple form of Coffey's still for the concentration of dilute naphtha wash.

In the district under notice, pyroligneous liquors are devoted to the manufacture of white (or gray) and brown lime acetates, white and brown lead acetates, crude and purified soda acetates, and both miscible and solvent wood naphtha. Culinary acetic acid is made at at least two works in the principality.

Carbonising retorts are here more generally known as ovens, and the carbonising process as stewing.

For all purposes it is found best to let the crude oven liquors have perfect repose for at least 24 hours before further dealing with them. If after the first period of repose they are drawn off from the deposited tarry oils, and then thoroughly agitated in another tank, and left for a further period of repose, so much the better. More tarry matters separate by gravitation.

For both brown sugar of lead and white or grey lime acetate the liquor is transferred from the reposing tank to a still, and then first the spirit and next the acid worked off into separate receivers. Copper stills are sometimes used for this process, and are heated either by direct contact of hot gases brought from an adjacent fire, or by means of an internal coil supplied with steam of from 20lb. to 30lb. gauge pressure, the corresponding range of coil temperature being thus from 228° to 250° Fahrenheit.

Cast-iron stills having either flat, hemispherical, or conoidal bottoms, and heated around the sides only by means of a wheel draft from a side fire, are in more general use for this process, but the coil-heated copper stills give, as might be expected, the best result as regards purity in the acid worked over, with, however, a corresponding slight diminution in quantity. The tarry residue in all these stills requires to be run out hot. In the case of coil-heated stills this requires to be done after every charge. Where fire-heated cast-iron stills are used, the residue is generally allowed to accumulate until a depth of about 2ft. of tarry matter exists in them. The stills are so proportioned for their charge that this shall occur at about fortnightly intervals. During an interval, 11 or 12 charges (one per day) are worked off, and at the end of the fortnight, after the acid from the last charge has been worked over, a higher heat is applied, and the tarry residue distilled until it attains a pitchy consistence on cooling. This condition is determined by withdrawing a portion from time to time on a rod passed down into it

through a stopper hole in the still cover. When the residue is sufficiently concentrated it is tapped out through the bottom, and either used in admixture with coal as fuel or sold as pitch.

When used for making brown lead-salt, the distilled acid is warmed (generally in a fire-heated pan) before litharge is added. The latter is thrown in in limited quantities, and while it is dissolving the liquor is vigorously stirred to keep the oxide off the bottom and hasten its solution. Scum and tar are carefully skimmed off as they rise. As saturation proceeds the temperature of the bath is increased by urging the fire. As soon as neutralisation is effected the liquor is syphoned off to concentrating pans, the fire under the mixing pan being damped down meanwhile. As soon as the liquor becomes syphoned off sufficiently low the bottoms in the mixing pan are ladled out and washed with strong distilled acid to exhaust them of any free litharge present. Evaporation of the liquor syphoned off is effected by means of steam coils laid in the pans. The liquor is concentrated up to caking density and is then ladled out into moulds for solidifying.

When devoted to the manufacture of white or grey limesalt the distilled acid is neutralised while cold, the temperature, however, rising spontaneously during the process. Prolonged stirring brings up tarry matter which is skimmed off. The "killed" liquor is next allowed to repose for 20 or 24 hours, and is then transferred to one or more fire-heated evaporating pans and carefully boiled down to nearly dryness. All tarry matter that rises to the surface of the liquor until the limesalt begins to "thicken out" is carefully skimmed off.

No mother liquor is separated in either the foregoing lead or limesalt process.

The above method of producing "distilled" (or white or grey) limesalt differs slightly from that described by Mr. Fawsitt (*Journal*, p. 320, 1st paragraph) in one respect—namely, that in Scotland the spirit and acid distillates from the pyroligneous liquor are not kept separate, but instead are together treated with lime and then the spirit is distilled off to make it into a miscible product. By this method of neutralising the lime deprives the spirit of some of its tarry oils, which to that extent may be expected to deepen the colour of the residual limesalt.

In our district the spirit obtained by the foregoing process is almost invariably marketed as *solvent* naphtha. This is not usually sold subject to any minimum limit of strength, but it must be nearly water white and keep its colour tolerably well while in druggists' stock.

It is more in request than miscible naphtha amongst varnishers and polishers for some purposes. The price it commands generally approximates to about three-fourths of that of miscible. It is prepared by simple concentration in copper stills heated by either steam coils or jackets, the first naphtha still, however, being sometimes worked over hot gases brought from a firegrate outside of the still-room. At some works nothing whatever is put into the stills with the charge. At other places a limited quantity of slaked lime is added to the charge for one or two of the rectifying operations, but sometimes in the last one only. Solvent naphtha customarily gets one distillation less than miscible, and is consequently not so strong. When finished the strength registers from 35° to 50° over proof, but owing to the increase of density from oils in solution it contains more spirits than so shown, especially in the case of the lower strengths.

From what has been said, it is clear that commercial solvent naphthas must be variable in composition. The yield of solvent is considerably in excess of that of miscible, and this in part compensates for the lower price obtained for it; but it would, in my opinion, have been generally more profitable in the past to have strongly limed it while weak and then worked it forward for miscible. Commercial solvent is often limed and re-distilled by methylators when the difference between the prices of the two descriptions affords a profit on the operation or when miscible is scarce.

Manufacturers who followed the white limesalt and solvent naphtha process used to be further remunerated by obtaining from 5d. to 9d. more per unit per cent. of acetate of lime in their limesalt than could be obtained per similar unit in brown limesalt. Of late years consumers have not been willing to pay so large a difference for the purer salt, and consequently its manufacture, as well as that of solvent naphtha, has fallen off. It may be expected that the increasing scarcity of the latter will enhance its price.

In our district the method which produces brown acetate of lime and miscible naphtha is most generally followed.

For this process the pyroligneous liquors are after a period of repose decanted, and then neutralised with slaked lime as the first step. Whether in respect of both quality and quantity of lime salt and naphtha the liquor ought to be accurately neutralised, or else either under-limed or over-limed, much difference of opinion exists. Whichever may be the practice followed in this respect, it is of importance that plenty of time and labour should be bestowed upon the operation. Prolonged agitation and careful skimming-off of the tarry matters thrown up will much improve the quality and appearance of the limesalt. Litmus paper is sometimes used as an indicator, but more generally the changes in colour, taste, and smell of the liquor, as well as some frothing and weak effervescence, are relied upon to notify the degree of saturation. Naturally the purer the lime used for neutralising the less will be the quantity of undissolved sediment (from some limes granular, from others slimy), and correspondingly one source of loss from imperfect drainage and washing will be minimised.

After settlement the clear limed liquor is transferred to the first still—in some places designated the wash boiler, and at others No. 1 still. It usually consists of some form of wrought-iron boiler, and is heated directly from a fire beneath. Occasionally internal steam coils are used, the object being to prevent the formation of hard deposit difficult to remove, which sometimes occurs on bottoms over fires.

Distillation is continued until all the naphtha has passed over. Roughly the quantity of this distillate amounts to from 20 to 25 gallons per ton, or per 100 cubic feet of cordwood retorted. One means of determining whether all the naphtha has come over is that of casting a small portion of the latest runnings over a shovelful of white hot fuel, clear of smoke, and carried to a dark corner. If there is no flash of flame then it is assumed that all the spirit has been driven over. This rough-and-ready test, in universal use, Mr. Fawsitt justly condemns. Another test is that of density, but this is not more trustworthy than the flash test, because owing to oils in solution naphtha in quantity worth recovering may be present when the density registers 1·000. Naturally stillmen are averse to having much liquor of such a density worked over, nevertheless to err from excess rather than defect in this direction is better for the proprietor's interest. Any crude spirits that fail to be driven over in this operation become lost. Every wash boiler has a habitude of its own that needs to be taken into account. For instance, I at one time had to do with one heated by a fire underneath, whose initial rate of delivery was usually from 10 to 11

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gallons per hour, at a strength of from 65° to 70° under proof—but both strength and quantity varying in part with the strength of the charge. Four hours after starting to run, and with the fire kept as near as might be of the same intensity, the delivery would have fallen off to perhaps 7 or 8 gallons per hour, and the strength to 80°—more or less—under proof. If later on, when 3 or 4 gallons of distillate per hour was coming off at say 90° under proof, the fire was checked (either by lowering damper or slightly opening the fire-door) so as to appreciably diminish the quantity coming over, then the strength would go up to say 87° under proof. And later still, towards the end of the operation, when only a fine wire stream was running, that would register 100° under proof. If then the fire was checked to reduce the delivery to a dribble the strength would go up to 99° or 98° under proof. This arose from the large amount of unclothed upper surface exposed by this still, which was a wagon boiler that at one time had been employed for steam generation. The large amount of cooling surface fractionated the vapours inside by condensation—a process which I suppose might be called dephlegmation. The best results were not to be got from this still by clothing the exposed surface (for this means lowered the mean strength of the distillate, or in other words, increased its quantity), but by long and slow working when the distillate was getting weak.

Instances are, however, to be found where too large a proportion of cooling to heating surface obtains in the wash boiler. I have met with such a case at each of two different works, and in both cases the yield of naphtha was unsatisfactory.

The residue in the wash boiler, after removal of the naphtha, is run out into evaporating pans (generally of wrought iron) and boiled down nearly to dryness. The limesalt is lifted out to strainers, and after from twelve to twenty hours' draining (the longer the better) it is next spread over a drying floor, which in most cases is formed over the carbonising ovens.

Except a small and constant quantity of liquor left on the bottom of the pans each day all the rest is thickened out, and thus no mothers have to be dealt with.

The wash boiler is cleaned out either weekly or fortnightly, preferably the former. In fire-heated wash boilers towards the end of each operation some tarry oils come over which float in spots on the surface of the distillate. Pungent incondensable vapours, of disagreeable smell, come off earlier in the process and continue to the end. Both of these increase as the sediment accumulates within the boiler. Cleaning is more easily effected when underliming of the oven liquor is practised. When, however, the boiler is wrought iron the rivet heads in time become corroded from underliming and leaks are set up. Overlimed liquor is apt to deposit tough sediment in this still, and also to prime over into the condenser. The residue when run out from the still to the boiling-down pans is also liable to froth up and boil over during evaporation.

At some works the limed pyroligneous liquor is run direct into hemispherical or saucer-bottomed cast-iron evaporating pans, to which movable cast-iron covers are applied after charging, and next a connection is made from a hole in each cover to a condenser by means of a portable pipe. The naphtha wash is first distilled off from each pan and then the cover is removed and the remaining liquor boiled down to nearly dryness. Next the limesalt is taken up, drained and kiln dried. By this method of boiling down the sediment usually intercepted in the wash boiler (as before mentioned) becomes incorporated with the brown limesalt and to that extent deteriorates it.

At this point I may make reference to the value of hot limesalt liquor, as it leaves the wash boiler, for cleansing the condensing pipes connected with the carbonising retorts. Usually these are cleaned out at from monthly to four-monthly intervals, as may be deemed necessary. At some works cleaning is, where practicable, done by means of scrapers. Where bends interfere with scraping the condensing tanks are sometimes drained of water, and either the pipes disconnected or else heat from cages of fire radiated on to them to melt out their internal coating. If instead of these means the pipes are filled up for a couple of hours with brown limesalt liquor charged hot the deposit within them becomes very completely removed. Naturally there is a better result when the outside condensing water has been previously drained off, but in cases where this cannot be done a second charge of hot liquor perfects the cleansing of the pipes.

I may also mention here that a small proportion of this limesalt liquor added to common alluvial clay makes a first-class lute and lute-washing for the retort doors. This addition, besides increasing the adhesiveness of clay lutes generally, also entirely prevents the cracking which is apt to occur in them while drying. The same luting is also excellent for still covers.

The weak naphtha distillate from the wash boiler or No. 1 still is mostly concentrated by passing through a series of stills, generally four in number, of diminishing capacity. Sometimes all these are of copper, but generally the first one, and sometimes the second, is of either cast or wrought iron. Some people hold that copper condensing pipes are indispensable for this series. Others use iron, lead, and copper in succession, the copper being connected with the finishing still. I have seen unsurpassed miscible naphtha made year after year by means of iron condensers for the first stills and lead ones for the last two. On the whole, copper condensers are preferable, and, in these last days at least, the price of the metal is no impediment to its adoption.

Where over-liming of the crude oven liquor is practised, ammonia comes forward with the naphtha distillate from all the stills. In such circumstances the first stills wear very well when of wrought iron. Generally the ammonia is intercepted in the finishing still. This is done by adding oil of vitriol to the charge—a proportion of about one or one and a quarter pints per 100gal. of spirits of 55° over proof being generally sufficient to redden test paper. I am not aware that it is ever attempted to recover the ammonium sulphate from the still residue. It would hardly pay for being done.

When under-liming is practised, the ammonia goes forward with the lime-salt to the kiln, and thence to market, if it survives the kiln. It is sometimes alleged that the odour of under-limed lime-salt is more agreeable than that of over-limed, and also that it keeps crisper and drier in stock.

Whether more tarry matters come forward or not in the distillate from the wash boiler when under-limed liquor is treated, is a point upon which wood distillers are not agreed. The measure of fouling of the succeeding stills might be expected to decide the matter. From never having had to do with a plant consisting of a cast-iron wash boiler, and copper concentrating stills throughout, I myself have not had sufficient experience of under-liming to enable me to offer an opinion, but I have been assured that when under-liming is practised, the tarry and colouring matters in the residues of Nos. 2 and 3 stills (the wash boiler counting as No. 1), will run away and leave a clean still if tapped off hot, and for this reason only a small quantity of slaked lime, if any, is added with

the charges to those stills to prevent adhesion of a deposit. It is also stated that only a little lime is required in the succeeding stills for discolouring their distillates, and that naphtha so produced is perfectly miscible, of good smell and retentive of its water-white colour. In the absence of ammonia, from pursuing this method, no acid is used in the finishing still. Doubtless the lime used in this process is sufficient to decompose any acetate of methyl brought forward in the wash boiler distillate from under-limed liquor.

When the oven liquor is slightly super-saturated with lime, the wash boiler distillate from it can, in the next concentration, be worked without any addition of lime to the charge, but the residue must be tapped off warm. This system obviates the necessity of frequent cleansing of the still, which sometimes has projecting rivet heads over the bottom inside, or else a heating coil close to the bottom—either being an impediment to cleaning out.

But in the next operation lime must be used, otherwise a tarry coating will be deposited that will not run off, even if the residue be tapped out at full heat, nor can it be removed by scraping after the still is cold.

This still, if a jacketed one, must be kept clean, otherwise it will not exhaust its charge to a sufficient extent. The strength of its charge will register perhaps from 5 to 10 degrees under proof. The addition of from 15 to 20lb. of slaked lime per 100gal. of such a charge will prevent any adhesion of deposit on the still bottom, and enable the sediment to be easily swilled out with the residual liquor and leave a bright still. It is better to strew in the lime in the form of dry powder than to add it in wet clots. The latter disintegrate with difficulty even under prolonged stirring.

For the succeeding operation, about one-third of the foregoing proportion of lime may be sufficient to add for keeping a clean still. The distillate from this last-mentioned operation is usually almost wholly freed from colouring matter, and it only remains to make the final concentration and remove the ammonia to produce a spirit of good smell, permanently colourless, and perfectly fit for the market.

I have next to notice the application for the rectification of wood naphtha of a still on the principle of Coffey's. I am not aware that this still has been so employed outside of this district. It was adopted in the Forest of Dean, in 1870, at the instance of the late Mr. Ernest T. Chapman, F.C.S., who at that date was connected with the erection of a wood distillery there. The still was intended to deal at first hand with neutralised oven liquor, and to concentrate it up to 40° or even 60° over-proof in one operation, and thus as a substitute for the No. 1 or wash still to supersede the use of at least two succeeding stills in the ordinary suite.

Two Coffey stills—locally designated plate stills—were erected, but when they were put to work it was found that although they would concentrate up to 60° over proof in one operation, the quantity of weak liquor they were capable of dealing with was surprisingly less than had been expected; and further that owing to solid matter held in suspension in the neutralised liquor (even after 24 hours' standing), and also the tarry matters present, deposition of solid matters occurred to such an extent in the upper parts of the stills as to choke them up after a few days' working. In consequence of this unlooked for result, a wash boiler was erected, and the plate stills were applied to dealing with its distillate. For this duty they ultimately gave satisfaction, but not until a long period had been spent in finding out the best way of dealing with them, several alterations having also to be made both in them and their adjuncts. Later on it was deemed to be in one respect safer to take off their distillate at from 10° to 20° over proof rather than to concentrate it to a higher strength, because, owing to the circumstance that on three different occasions excise officers in London had refused to pass their produce for methylating, upon the ground that it was too pure in quality and deficient in smell, it was concluded that (1) the greater amount of re-distillation effected within the stills tended to over-purify the product, and (2) that the lower temperature prevailing in the upper parts of the stills, when high concentration was going on, disabled some of the usual strong-smelling bodies from vaporising and going forward with the naphtha spirit. The purifying tendency in this case seemed to be almost identical with the action of stills of similar principle devoted to the production of "silent" ethyl alcohol.

Since the time when it was concluded the plate stills were liable to make the naphtha too good, the proportion of concentration effected in them has ranged from about 4½ to 1 to 5¼ to 1 by volume:—thus 1 gallon of 10° over proof has been collected from each 4¾ gallons of wash, registering by hydrometer 83° under proof (but being actually about 77° under proof) entering the still; and one gallon of spirit 17·7° over proof has been separated from each 5¼ gallons of wash of 86·3° under proof by hydrometer test entering the still—the wash being, however, actually not weaker than 77·3° under proof, as proved by the amount of spirit collected. The former example is an average of the work done by a still composed of a pile of 22 trays or plates, each plate being a flat rectangle 3ft. long by 1ft. wide in the clear inside of a flange 1½in. high, which stands up vertically all around the margin of the plate. The plates are of cast iron, ½in. thick throughout, and are 3ft. 1in. long by 1ft. 1in. wide by 2in. deep externally. The flanges are planed true on their upper edge, and, similarly, an arris about 1in. wide is planed all around the margin of the outer side of the bottom. Thus the even top edge of the lowest plate in the pile is borne upon by the even margin of the bottom of the next plate above, and so on upwards—the top tray being covered by a plain flat plate. Two or three coils of fine soft twine are laid around on the top edge of each flange, and painted over with thin white-lead putty to form a joint with the bottom of the next plate. The whole pile is cramped together by means of vertical bolts outside. Near one end of each plate (except the lowest one) three holes exist in the bottom—the two side ones being appointed for letting liquor pass through downwards, and the middle one for letting vapour pass upwards. A little fillet or flange, standing ½in. high, surrounds each of the liquor holes, and these flanges keep the plate covered with a stratum of liquor ½in. deep. The flange surrounding the middle hole is 1in. high, and as, therefore, no liquor can overflow to descend through it, it is kept clear for the ascent of steam and spirit vapours. In building the still the second plate laid will be the first having holes in its bottom. The third plate is laid with its holes "end for end" with those in the second one, and succeeding plates are so reversed in succession to the top.

A regular stream of weak naphtha wash being supplied to one end of the top tray flows over it to the other end and flows down to the next plate below. It then traverses this plate to the opposite end and falls through to the next below, and so on to and fro to the bottom—each plate meanwhile being covered with a layer of liquor half an inch deep. Steam of from 5lb. to 20lb. gauge pressure enters at one end of the bottom plate through a ½in. pipe, the supply being regulated by a stop valve. The steam travels up-

wards through plate after plate and traverses the surface of the liquor in a direction contrary to the flow of the latter. The steam keeps the liquor on several of the lower plates at boiling point and completely deprives it of all naphtha. At some point higher up all the steam becomes condensed except such as goes forward in connection with naphtha vapours, and at a temperature below 212° F. Above the horizon of complete steam condensation the temperature within the still goes on decreasing, and while the supply of wash and steam must be mutually regulated so that all the spirit shall be separated from the former the supply of both must be restricted so that the temperature within the upper trays shall not exceed a certain limit, which varies with the strength of both the distillate collected and wash supplied, and, slightly, from other circumstances. The temperature at the top of the still can, of course, be ascertained by means of a thermometer, but generally the stillman obtains sufficient information from lightly feeling the plates with the palm of his hand. Seldom is there any variation for hours together, but when there is he directs his attention to the wash supply and the pressure (for temperature) of the steam supply.

The boiling spent wash escapes from the bottom plate through a vertical U tube about 3ft. deep. This tube provides about 1¼lb. per square inch of back pressure to prevent the entering steam from escaping by a short cut through the wash exit pipe, and at the same time constitutes a safety outlet in the event of any accidental choking of the exit-pipes above. Of course while all is clear above there can be no appreciable pressure within the still. The naphtha picked up by the ascending steam and vapours passes out from the top plate through a pipe to a worm within a cast-iron condensing tub, supported at a point a little higher than the still top. Within this worm the more watery portion of the naphtha vapour is condensed and flows back direct to the top tray of the still. The uncondensed vapour from the first worm passes on through a second worm and tub wherein a further portion is condensed and returned to the top of the still. In the early history of these stills, while a stronger distillate was being produced, the condensation from a third worm and tub was also conveyed to the top tray of the still, but now all that condenses beyond the second tub is retained outside of the still. The wash supplied to the still passes first through the worm tubs and constitutes their condensing medium. Its temperature is increased in each succeeding tub, and it enters the still more or less hot.

No attempt has been made to utilise the heat carried off by the spent wash at boiling temperature. Some heat is also lost by radiation from the surface of the stills. They have never been clothed, because it was thought desirable to have the tray joints always available to inspection. Roughly, one of these stills with condensing tubs exposes about 40 superficial feet of surface, and may be expected to lose heat equivalent to the condensation of say 10lb. of steam (equal to one gallon of condensed water to the escaping wash) per hour. Much of the heat passing from the still in the naphtha vapours is captured by the wash passing through the condensing tubs and carried back to the still therewith. By deducting the quantity of wash entering the still from the sum of the quantities of spent wash and strong distillate escaping from the still the quantity of steam expended for working the still may be ascertained.

The wash supplied to these stills usually ranges from 80° to 90° under proof by Sikes's hydrometer, but for the reason before stated the wash is always richer in spirit than its density referred to Sikes's tables indicates. As before mentioned, the first-stated example of concentration from 83° under proof to 10° over proof was taken from a still of twenty-two trays. At 3 feet per tray this still provided 66 superficial feet of liquor surface for direct contact with the steam and hot vapours. The supply of wash was at the rate of 13·58 gallons per hour, and the yield of distillate 2·85 gallons per hour. The second example (86·3° under proof wash concentrated to 17·7° over proof product) was from a still of twenty-seven trays, which thus provided 81 superficial feet of liquor surface for contact with steam and vapour. These examples show that for a concentration of dilute liquors of the strength stated to about one-fifth of their volume approximately 5 superficial feet of plate surface per gallon of wash supplied per hour is necessary.

By the time that from 5500 to 6500 gallons of wash has passed through one of these stills, so much deposit has generally accumulated within it—chiefly in the upper part—as to interfere with the passage of liquor and vapours. The trays have then to be cleaned. Convenient facilities for effecting this were not provided in the stills under notice, and consequently they have to be taken apart for the purpose.

As soon as a stillman has learnt to adjust the supply of wash and steam to these stills they afterwards give him very little trouble. They run for hours without requiring more than the most trifling attention.

An ordinary No. 2 still does not operate upon more than 150 gallons of wash boiler distillate per operation. To get 6000 gallons through such a still it would have to be charged, luted down, worked off and run out 40 times, and portions of the distillate from each operation would have to be caught according to strength in separate vessels, and a portion of it repassed through the same still. Furthermore the average strength of the first portion of the distillate kept separate for treatment in the succeeding still would certainly be something below proof in strength. From these points I think it will be seen that the method of distillation in plate stills just described is an improvement upon that which commonly obtains for weak naphtha liquors.

I will next make reference to the yield of some of the products from wood distillation. Assuming an ample and efficient condensing apparatus for dealing with the vapours from the carbonising ovens, then the quantity and strength of the pyroligneous distillate obtained most largely depends upon the amount of non-constituent water resident in the wood treated, and next upon the temperature of carbonisation.

It being in this district most customary both to buy wood and sell charcoal by bulk instead of weight, we are accustomed when speaking of yields to refer to our "cord" of wood as the unit for comparison. Our cordwood is (or ought to be) cut to a length of 2ft. 2in. and the ordinary standard cord consists of a rank of such sticks piled transversely to a height of 2ft. 2in. Thus the volume of a cord is 78¼ cubic feet nearly, and when composed of bark-stripped coppice oak of about 14 years' growth weighs from 14cwt. to 16cwt. The coppice oak just mentioned can often be obtained in large quantities, and gives as good yields as any other description of wood that can be obtained in similar quantities.

Assuming that a cord of coppice oak weighs 15cwt. when well air-dried, and that a bushel of charcoal from it weighs 13¼lb., then good working yields in this district per 100 parts by weight of such wood are as follow:—

Liquid Distillate (tar, crude acid, crude naphtha, etc.	Acetic Acid (glacial).	Naphtha, density ·8263.	Charcoal.
50 to 60	3·44	1·03	31·25

If the cord be taken to weigh 16cwt. then the foregoing figures representing yields must be abated one-sixteenth. The density of the crude acid and spirit liquor varies from 4° to 5½° Twaddell. It may be noticed that our yield of acetic acid is much under that realised in Scotland as stated by Mr. Fawsitt. He did not state their yield of naphtha.

Notwithstanding there are so many encyclopædical treatises and monographs on wood distilling, none of them, so far as I am aware, give analyses of either brown sugar of lead, white or grey limesalt, or solvent and miscible naphthas. We are now indebted to Mr. Fawsitt for an analysis of miscible naphtha. The following analysis of presumably brown limesalt appears at page 2 of Thomson's Dictionary:—

*	Acetic acid	48·22 $C_2H_3O_2$
	Lime	35·00
	Carbonate of Lime	8·17
	Tarry matter	2·99
	Water	5·62
		100·00

The proportion of tarry matter appears to be low and of water high. It may also be remarked that the acetic acid requires for its saturation only 26·47 units out of the 35·00 of lime present, leaving an excess of 8·53 per cent. of lime present in the salt. Some of this is perhaps engaged with the tarry matter. On the whole this seems to be a very highly limed sample, and remembering that the crude acid is neutralised with slaked caustic lime, how is it that carbonate of lime appears in this salt?

Brown limesalt is usually sold guaranteed to contain 70 per cent. of anhydrous lime acetate. Much that is delivered contains from 72 to 75 per cent.

Before concluding I would like to make brief reference to the custom of selling miscible naphtha by tests referring to Sikes's hydrometer tables—a practice that Mr. Fawsitt does not entirely approve of. In one respect, however—namely, that of ascertaining the amount of water present in miscible naphtha, it would seem from Mr. Fawsitt's determinations, that Sikes's tables are fairly accurate, as the following examples will show:—

Miscible naphtha of ·829 density Mr. Fawsitt shows contains 12 per cent. of water. By Sikes's tables hydrated alcohol of the same density (60° over proof) contains (proof spirit to consist of 49·3 per cent. of absolute alcohol and 50·7 per cent. of water by weight) 12·49 per cent. of water. By the table in Fownes' Chemistry alcohol of the same density contains 12·42 per cent. of water. Next from Messrs. Dittmar and Fawsitt's determination of the naphtha in wood spirit of ·815 density it contains by inference 7 per cent. of water. By Sikes's tables common alcohol of the same density (67° over proof) contains 7·15 per cent. of water, and by Fownes' table 7·33 per cent. of water.

I have not met with any explanation why the zero of Sikes's hydrometer was placed so high as ·815 at 60° Faht. By the tables it will be seen that at 47° Faht. this density represents 70° over proof, containing by computation 4·93 per cent. of water. In the tables for still lower temperatures the strength corresponding to zero is not given; in fact, nowhere is a higher strength than 70° over proof specified, and this circumstance has led many (myself included at one time) to suppose that 70° over proof represented absolute alcohol.

Taking it as before, that proof spirit contains 49·3 per cent. of alcohol; and, further, that alcohol at 60° Faht. has a density of ·7938, then for Sikes's tables absolute alcohol would be represented by 75·1° over proof.

In working wood naphtha through the finishing still the first and strongest runnings rarely exceed 65° or 66° over proof. The highest I have met with was 68·7 over proof.

During the discussion a member, referring to the analysis of brown limesalt set before the meeting, suggested that the presence of carbonate of lime arose in this way: An excess of caustic lime was used for neutralising, and some of this became carbonated later on while in the drying kiln.

*: 48.22 $C_2H_4O_2$ or $C_2H_3O_2$
22.50 $Ca''O$
8.17 $Ca''CO_3$
12.50 ~~[illegible]~~ CaO with tar acid?

Obituary.

ALFRED TRIBE, F.C.S.,

LATE LECTURER IN CHEMISTRY AT DULWICH COLLEGE, ETC.

Alfred Tribe, whose name has become well known both in this country and in Germany, through his physico-chemical researches in conjunction with Dr. Gladstone, F.R.S., was born in the year 1839, in the neighbourhood of Oxford Street, London. He spent the first years of early childhood at Bradford-on-Avon. Returning to London when six years old, his education was carried on there, and as a boy he attended the Royal College of Chemistry in Hanover Square. Here he acquired a knowledge of chemistry, and received encouragement from Prof. A. W. Hofmann. In 1855 he became assistant to Dr. Medlock, subsequently to Dr. Forbes Watson, who had a laboratory in Archer Street, Westbourne Grove, and more recently to Prof. Williamson and Dr. Bernays. In 1862 Mr. Tribe went to Heidelberg and studied under Bunsen; in 1863 he returned to St. Thomas's Hospital. He became in 1865 private assistant to Dr. Gladstone, and in 1877 was appointed lecturer on Metallurgy at the National Dental Hospital. As lecturer on Theoretical and Practical Chemistry at Dulwich College, for which appointment he was chosen in 1874, he continued up to the time of his death, retaining also the two other appointments at the Dental Hospital, and under Dr. Gladstone. The principal papers communicated by him were on "The Freezing of Water and Bismuth," *J. Chem. Soc.*, 1868; "A Specific Gravity Bottle for Spontaneously Inflammable Liquids," *Phil. Mag.*, 1873; "The Agglomeration of finely divided Metals by Hydrogen," *J. Chem. Soc.*, 1874; "Experimental Contributions to the Theory of Electrolysis," *Proc. Roy. Soc.*, 1876 and 1877. In conjunction with Dr. Gladstone he published a number of papers, the principal of which are entitled, "A law in Chemical Dynamics," *Proc. Roy. Soc.*, 1871; "An Air Battery," *Proc. Roy. Soc.*, 1873; "Researches on the Action of the Copper Zinc Couple on Organic Bodies," in 10 parts, *J. Chem. Soc.*, 1873 and 1885; "Various papers on the Copper Zinc Couple, and its preparation," *Proc. Roy. Soc.*, 1872, and *J. Chem. Soc.*, 1873 and 1879; "A series of papers on the Joint Action of Aluminium and Iodine on the Alcohols and Ethers," *J. Chem. Soc.* 1876 and 1885; "Investigations into the Action of Substances in the Nascent and Occluded Condition," *J. Chem. Soc.*, 1879. In 1883 he published, in conjunction with Mr. Gladstone, a small treatise in the Nature series of Messrs. Macmillan,

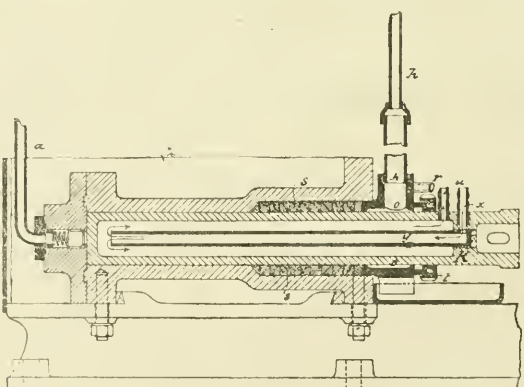
entitled "The Chemistry of the Secondary Batteries of Planté and Faure." Mr. Tribe took out some patents in connection with the secondary batteries; in these Dr. Gladstone had no interest. In 1866 Mr. Alfred Tribe was married. He has had a large family, and now besides Mrs. Tribe, a son 16 years of age and three very young children remain. His death took place on November 26th, 1885.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Machines or Apparatus for the Manufacture of Ice. H. H. Lake. From Wm. Raydt, Hanover, Germany. Eng. Pat. 15,475, November 24, 1884.

This invention relates to apparatus for the production of cold and the manufacture of ice, by means of the use of carbonic acid instead of liquids such as ether, ammonia, or sulphuric acid, carbonic acid having the advantage of being cheaper than the other fluids, besides being capable of producing greater cold. Thus a much smaller compression pump can be used than with other liquids; for instance, only about one-sixth of the size of that required for ammonia. On the other hand, carbonic acid must be worked under much higher pressures (from 30 to 75 atmospheres), and therefore it requires a compression pump of special construction. Several designs of pumps are given in the specification, of which the woodcut represents one. The principal considerations in the construction of the pump, are the necessities of keeping it cool, and of preventing the escape of the acid through the stuffing box. For the latter purpose the inventor provides the gland with a circular chamber *o*, into which any acid escaping from the stuffing box *s* is carried, and led by means of the pipe *h* to a small gasholder, from which it is returned to the pump either by suction or by injection. The chamber *o* is also connected through the tube *r* with an oil reservoir, by means of which the stuffing box *s* is kept properly lubricated, whilst any escape of either oil or acid is prevented and cut off by the auxiliary gland *t*. The pump is surrounded by liquid in the cistern *z*, for the purpose of cooling, which is further aided by the circulation of a cold liquid through the plunger, by means of the tubes *x*, *y* and *u*, shown in the drawing.—B.



Improvements in Filters, and in Arrangements for Filtering. W. Oldham, Manchester. Eng. Pat. 16,326, December 12, 1884.

This invention relates principally to improvements in the application of the filters described in the Patent 7831, 1884, and to means for connecting a number of them to act together, and for cleaning, removing or replacing them.—B.

Improvements in Apparatus for Separating Solid Impurities from Water or other Liquid. A. Howatson, London. Eng. Pat. 16,706, December 19, 1884.

The inventor constructs apparatus for depositing and removing solid impurities contained in water or other liquids, by arranging in a vessel of any convenient shape a number of superimposed trays or plates, each tray having a number of wells or recesses with inclined sides, and terminating below in small openings. All these openings of the wells of each tray are connected by one or more closed channels or tubes, which are carried through the sides of the containing vessel to a common discharge pipe. The impure water or liquid enters the vessel from below, and traverses upwards in a serpentine path over each successive tray, allowing the impurities to settle and slide down the inclined sides of the wells. Here they collect in the small channels, whence they are drawn off at intervals. The cleared liquid leaves the vessel at the upper end.—B.

Improvements in Filter Presses. J. H. Johnson. From F. and R. Quarez, Paris. Eng. Pat. 2642, February 26, 1885.

The improvement in filter presses contemplated by this invention refers to the mechanism for applying the pressure, and to the passages which carry the liquid through the press plates. The improvement in the pressure mechanism enables an additional and adjustable pressure to be applied, after the nuts of the two main bolts, which hold the plates together, have been screwed home. The press plates consist of alternate "water plates" and "juice plate," and the improvement refers to passages left through the plates, and which are arranged to allow for the proper circulation of the washing or displacing liquid, with the view to force out the juices of the materials under treatment, in the order of their density, the object being to extract the denser parts of the juices before they shall have had time to become diluted by the displacing liquid. There are devices for regulating the admission or reversing the course of the liquid, if necessary, which

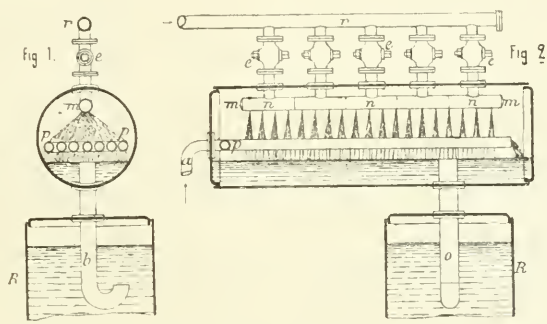
are indicated in the sheet of drawings accompanying the specification.—B.

Improvements in Thermostats. W. E. Gedge. From H. F. Perry, San Francisco. Eng. Pat. 10,049, August 25, 1885.

THE invention consists of a closed air-tight chamber, inserted into the room or space to be heated, and subjected to the same degree of heat. The chamber is in connection, by means of a tube, with a floating bell or air-holder, which is raised or lowered simultaneously with the expansion or contraction of the air in the closed chamber, according as the temperature rises or falls. The float acts upon a valve adjusting the admission of the air of combustion to the source of heat, thus regulating the heat of the room.—B.

New Condensation Apparatus. L. and C. Steinmüller. Ger. Pat. 31,238, September 13, 1884.

THE apparatus here figured is recommended for the condensation of the vapours of volatile liquids, as, for example, the benzine vapours from apparatus for the extraction of fat from bones. The vapours are led by the elbows *a* into thin-walled tubes *p*, or metal boxes. Each of the taps *e* supplies a separate division of *m* with water, which is thus distributed in jets over the whole surface of the condenser system *p*. The condensed product runs away, as shown, into the water, and the two liquids pass out through *o* into the tank *R*, where they separate.—W. D. B.



II.—FUEL, GAS, AND LIGHT.

Improved Means of Utilising Waste or other Gaseous Products of Combustion. E. Biedermann and E. W. Harvey, London. Eng. Pat. 15,127, August 17, 1885.

THE highly-heated gases escaping from regenerative gas furnaces are conducted through a chamber filled with fuel, which has been previously raised to incandescence by the admission of air in the ordinary way. The carbon diox de of the waste gases takes up another atom of carbon, becoming converted into monoxide, and becoming again available for fuel.—A. R. D.

Improvements in Carburetters. J. H. Johnson, London. From E. F. Delamare-Deboutteville and L. P. C. Malandin, Fontaine-le-Bourg. Eng. Pat. 15,248, August 19, 1885.

THE carburetting chamber is filled with sponges or other porous material, and is supplied with liquid hydrocarbon from a reservoir above by a pipe provided with a suitable glass for observing the rate of drip, so that a constant level of liquid may be maintained in the chamber. The carburetter is to be worked in connection with a gas engine, so that each stroke of the piston draws air through the chamber into the cylinder. The inlet and outlet from the carburetter are provided with suitable valves to prevent the return of flame from the engine or the escape of gas into the air.—A. R. D.

Process for the Separation of Carbonic Oxide from the Products of Furnaces or Gas Producers. A. R. Huntington, London. Eng. Pat. 15,310, August 20, 1885.

THE products of combustion are exposed to the absorbent action of a solution of cuprous chloride under the pressure of several atmospheres, the nitrogen being allowed to escape by a suitable valve. The carbonic oxide that has been absorbed is released by mechanical rarefaction, and collected as convenient. The cuprous chloride solution is preferably made by dissolving chloride of copper in solution of ammonium chloride.
—A. R. D.

Improvements in the Manufacture of Hydrogen. R. Lehmann, London. From Jacob Oettli, of Cossonay, Switzerland. Eng. Pat. 16,759, September 4, 1885.

STEAM is passed through highly heated tubes of refractory earthenware, partly filled with iron filings, and in which a partial vacuum has been previously produced. A certain proportion of hydrogen is added to the steam, and this, together with the action of the iron filings, tends to destroy the proportion between the oxygen and hydrogen formed by the decomposition of the steam, and to prevent them from re-uniting. This effect is promoted by the reduced pressure in the tubes, and by the loss of heat due to the splitting up of the aqueous vapour. From the tubes the gases pass through any convenient separators to gasholders.—A. R. D.

Improvements in Apparatus and Materials Employed in Producing Self-igniting Luminous Gas for Signalling Purposes. W. R. Hodgkinson, London. Eng. Pat. 16,464, September 14, 1885.

THE self-igniting gas is produced by the decomposition of sodium phosphide on access of a suitable liquid. The volume of gas evolved is increased by the addition of an alloy of sodium with some less readily oxidisable metal. Magnesium silicide may be substituted for sodium phosphide. For particulars of the apparatus employed the specification and drawings must be consulted.
—A. R. D.

The Present Position and Prospects of the Processes for the Recovery of Tar and Ammonia from Blast Furnaces. William Jones. Proc. Iron and Steel Institute Meeting in Glasgow, September, 1885.

"IN the West of Scotland there occur vast beds of coal, known as splint coal." This coal is admirably adapted

for blast-furnace purposes, giving a good, strong coke, capable of withstanding, in a high degree, the crushing effect of the ores, etc. Certain varieties of it agglomerate very little during coking, and do not decrepitate. The principal localities for furnace splint coal in the Clyde basin are: Bothwell and Hamilton district, Airdrie and Coatbridge, Quarter, Wishaw, Glasgow, Cambuslang, Rutherglen, Govan, etc.

Scotch splint coals contain on the average 40% of total volatile matter, of which 28 to 35 go to form tar, gas, etc., and they yield on the average 50 to 55% of fixed carbon. Were the average amount of nitrogen in Scotch splint coal (1·35%) all evolved as ammonia, and obtained as sulphate of ammonium, this would amount to 142½lb. of pure sulphate; but in blast-furnace practise only from 17 to 20% of the nitrogen contained in the coal is evolved as ammonia. The author considers the following method of deduction to give a very fair idea of the amount of sulphate of ammonia that may be obtained in practise on the large scale:—An average sample of the coal is tested for the amount of nitrogen it contains, the latter is calculated to ammonium sulphate, of which amount 16% is taken as the amount of pure sulphate that may be recovered. Taken as a whole, the gases from Scotch blast-furnaces have the following composition:—Carbonic oxide, 25 to 30; carbon dioxide, 3 to 8; hydrogen, 5 to 7; marsh gas, 2 to 4; nitrogen, 52 to 60% by volume. The temperature of the escaping gases varies from 400° to 650° F. (204½° to 343⅓° C.), and the volume of gas per ton of coal averages 125,000 cubic feet at 60° F. (15·5° C.). These 125,000 cubic feet of gas at 500° F. (260° C.), become over 230,000 cubic feet, and this volume is further increased by 300 to 400lb. of water per ton of coal in the form of vapour, arising from the hydrogen in the coal, and the water in the materials. Moreover, every ton of coal yields from 120 to 220lb. of tar, given off partly in the form of vapour at the above temperature, and partly in suspension. Some idea may thus be gained of the enormous gaseous volume per ton of coal issuing from the throat of a coal-fed blast furnace. The gases contain a considerable amount of dust, which should be got rid of before the actual condensation of the tar and ammonia. In recovering ammonia from the waste gases, experience has proved that it is best to maintain an outward pressure on the gas. A suction or inward pressure may not only lead to disastrous explosions, but it very much reduces the yield of ammonia per ton of coal, owing to the entrance of air and the consequent combustion of the ammonia. The tar in these gases is scrubbed out with great difficulty, owing to its peculiar physical condition, and its state of suspension in so large a volume of gases. No amount of cooling and washing is so effective as some form of violent mechanical action, such as dashing with water or otherwise. The different methods for recovering of tar and ammonia from blast furnaces may be grouped as follows:—

(I.) Methods depending on the condensation or cooling of the gas.

- (a) Alexander and McCosh process, or the Gartsherrie method.
- (b) Dempster process.
- (c) Henderson process.

(II.) Methods depending upon the use of acids, without the cooling of the gas.

- (a) Neilson process, or Summerlee method.
- (b) Addie „ or Langloan „

ANALYSES OF SAMPLES OF FURNACE COALS.

.	Splint Coal used at Gartsherrie.	Greenhill Splint Coal.	Rosehall Splint Coal, used at Langloan.	Rosehall Soft Coal, used at Langloan.	Earnock Ell Coal.	Carron Iron Company's Main Coal.	Slamannan Steamboat Coal.	Westrigg Steam Coal.	Denny Steam Coal. R. Addie and Sons.
Carbon ..	70·05	71·12	70·01	73·99	72·81	—	81·07	79·55	81·64
Hydrogen	5·21	5·01	4·96	5·17	5·23	—	5·21	5·09	4·99
Oxygen ..	12·08	10·10	8·57	10·52	9·06	—	5·30	6·52	6·04
Nitrogen .	1·36	1·46	1·39	1·32	1·17	1·51	1·62	1·66	1·35
Sulphur..	0·75	0·91	0·78	0·51	0·88	—	0·42	1·02	0 69
Ash	3·80	2·21	5·20	1·10	0·96	—	4·65	1·17	1·01
Water ..	6·72	8·50	9·06	1·36	9·56	—	1·75	1·69	1·28
	100·00	100·00	100·00	100·00	100·00	—	100·00	100·00	100·00
Analyst ..	Dr. Wallace	Dr. Wallace	Mr. Tatlock	Wm. Jones	Dr. Wallace	—	Dr. Wallace	Dr. Wallace	Dr. Wallace

If the whole of the gases of all the furnaces at present in blast in Scotland were being treated for the recovery of ammonia, the turn-out of ammonium sulphate would be some 18,000 tons per annum, equal to 22% of the present production of Great Britain. Interesting details of the methods of carrying out the above-named processes are given, for which the original paper must be consulted.

—W. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

An Examination of the Phenol Constituents of Blast Furnace Tar obtained by the Alexander and McCosh Process at the Gartsherrie Iron Works. Watson Smith, J. F. H. Coutts, and H. E. Brothers. Part I. Proc. Chem. Soc., November, 1885.

By agitating the lighter creosote oils of the blast furnace tar with an equal bulk of caustic soda solution of 1·09 sp. gr., etc., the authors have obtained 17·5 per cent. by volume of crude phenols; while from ordinary gas retort tar, and also from Jameson coke oven oil, they have obtained about 5 per cent. However, by more exhaustive treatment with more concentrated soda solution, 23·1 per cent. of phenols were obtained from the blast furnace oil, and about 8 per cent. from the Jameson oil, which seems to be a nearer approach to the shale oil of the paraffin manufacturer; similarly, some 9 or 10 per cent. could be obtained from gas retort coal tar oil.

On fractioning the crude phenols from the blast furnace oil, only 5·63 per cent. by volume distilled over between 180° and 210°, 30·7 per cent. between 210° and 240°, and 18 per cent. between 260° and 300°. During the distillation of the portions boiling below 300°, and especially of the lower boiling portions, much sulphuretted hydrogen was evolved, and afterwards sulphurous oxide; at the same time a considerable amount of sulphur was deposited in the condenser. In fractioning the portion distilling from 300° to the coking point of the residue, when the latter point was reached both hydrocyanic acid and ammonia were evolved.

The phenols having been separated into groups boiling between certain temperatures, and these fractions purified as far as possible, they were distilled over

heated zinc-dust: the hydrocarbons metaxylene, trimethylbenzene (probably pseudocumene), and naphthalene were thus obtained, and from their formation the authors infer the presence of the corresponding phenols in the original oils. Phenol itself was separated in small quantity from the portion distilling between 180° and 210°, metacresol being the chief constituent of this fraction; metaxylenol was one of the most abundant constituents of the portion boiling between 210° and 240°.

Inasmuch as low temperature tars such as that examined contain extremely little phenol, whereas gas retort tars are comparatively rich in this body, and also because other homologous phenols are so abundantly present in blast furnace tars, it is difficult to accept Schulze's theory as exclusively sufficient to account for so much benzene as is found in gas retort tars. According to this theory, in the formation of aromatic hydrocarbons by the destructive distillation of coal, phenols are primarily formed, and subsequently suffer disruption at higher temperatures, yielding water and aromatic hydrocarbons. This may be the case to some extent, but it is likely that the synthetic reactions indicated in the theories of * Berthelot, Jacobson and Anschütz are also largely concerned in the production of the benzenes, naphthalene, anthracene, etc.—W. S.

Synthesis of Thiophen and Pyrroline Derivatives. C. Paal. Ber. **18**, 2251—2254.

By the action of phosphorus sulphide and of ammonia on acetophenoneacetone the author prepared phenylmethylthiophen and an analogous pyrroline compound. Acetonylacetone — $CH_3.CO.CH_2.CH_2.CO.CH_3$ — gives, under the same conditions, dimethylthiophen, or thioxen, and dimethylpyrroline.

Thioxen. — Three parts acetonylacetone are heated with two parts of powdered phosphorus penta- or trisulphide in a sealed tube for one hour at 140—150°. On cooling, the thioxen separates as a colourless oil, which may be purified by distillation over sodium. The yield of the product is 50—60 per cent. of the theoretical. B.P. 134—135°. With isatin and sulphuric acid it gives a cherry-red colouration; with phenanthrenequinone dissolved in glacial acetic acid a beautiful violet shade.

Dibromothioxen may be prepared by adding a solution of bromine in CS_2 to thioxen dissolved in CS_2. On evaporating the CS_2 a crystalline compound is obtained of the formula $C_6H_6Br_2S$; M.P. 97°.

Tribromothioxen.—The dibromo compound dissolves in excess of bromine with evolution of HBr. The product, after recrystallisation, melts at 142—144°, and has the formula $C_6H_5Br_3S$.

Methylthiophenecarboxylic acid is formed by the oxidation of thioxen with an alkaline solution of potassium permanganate; M.P. 142°.

Dimethylpyrroline is obtained by heating acetonylacetone with alcoholic ammonia in slight excess in sealed tubes for one hour, at 150°. The product is evaporated, and the residue distilled. The liquid boils at 165°, and is identical with that obtained by Weidel and Ciamician (*Ber.* **13**, 78) and L. Knorr (*Ber.* **18**, 1558).—J. B. C.

Thioxen from Coal-tar. J. Messinger. Ber. **18**, 2300—2303.

Acetylthioxen is obtained by the action of acetyl chloride (*Ber.* **17**, 2643) on pure thioxen in presence of aluminium chloride. 5grms. thioxen are dissolved in 100grms. petroleum spirit, 3·5grms. acetyl chloride added, and Al_2Cl_6 slowly introduced. A black oil and thick masses of organic aluminium compounds separate. The yield is improved by heating the mass occasionally on the water-bath after the addition of the Al_2Cl_6. On adding water, the acetylthioxen dissolved in the petroleum spirit swims on the surface, and may be separated by distilling the whole with steam, the receiver being changed when the petroleum spirit has passed over. Acetylthioxen is a colourless liquid, B.P. 223—224°; with hydroxylamine it forms a compound of the formula—$C_4SH(CH_3)_2.C(NOH).CH_3$. By the action of alkaline potassium permanganate, acetylthioxen is oxidised to thiophen-tricarboxylic acid; but the free acid could not be obtained pure. If, however, the product of oxidation be dissolved in ammonia, and the neutral ammonium salt precipitated with silver nitrate, a yellow silver salt is formed, which, on heating with methyl iodide in an ethereal solution, yields the methyl ether of thiophentricarboxylic acid—$C_4SH(COOCH_3)_3$.
— J. B. C.

* Compt. Rend. lxii. pp. 905, 947; Ber. 1877, p. 853; Ber. 1878, p. 1215.

IV.—COLOURING MATTERS AND DYES.

o-Xylidine and o-Xylenol [1:2:3]. A. Töhl. Ber. **18**, 2561—2562.

The author has prepared the only xylidine hitherto unknown—namely, $C_6H_3(CH_3)_2.NH_2$[1:2:3]. Dibromo-*o*-xylene—$C_6H_2(CH_3)_2Br_2$[1:2:4:5]—was converted by nitration into nitrodibromo-*o*-xylene $C_6H(CH_3)_2Br_2(NO_2)$ [1:2:4:5:3], and the dibromoxylidine obtained by reduction of this was debrominated with sodium-amalgam.

Nitrodibromo-o-xylene—$C_6H(CH_3)_2Br_2(NO_2)$[1:2:4:5:3]—forms colourless needles of melting point 141°.

Dibromo-o-xylidine—$C_6H(CH_3)_2Br_2(NH_2)$[1:2:4:5:3]—crystallises from alcohol in colourless needles, melting at 103°.

o-Xylidine—$C_6H_3(CH_3)_2NH_2$[1:2:3]—is a colourless oil, boiling at 222°, and remaining fluid at 15°. The hydrochloride ($B'HCl + H_2O$) forms large soluble plates, the nitrate ($B'HNO_3$) easily-soluble long needles, and the sulphate ($B_2H_2SO_4$) large plates. Its acetyl derivative forms long, fine needles, which melt at 131°.

o-Xylenol—$C_6H_3(CH_3)_2OH$[1:2:3]—was obtained from the xylidine by the diazo-reaction. It crystallises from water in long, fine needles, melting at 75°, and boiling at 218°; with Fe_2Cl_6 it gives a blue colouration.—A. G. G.

Derivatives of Pseudocumidine. K. Auwers. Ber. **18**, 2655—2663.

The pseudocumidine $C_6H_2(CH_3)_3NH_2$[1:3:4:6] was prepared by distilling commercial cumidine and crystallising the fraction 232°—235° from strong alcohol. It forms large colourless prisms, melting at 68° and boiling at 234°.

Acetylpseudocumidine—$C_6H_2(CH_3)_3.NHAc$—obtained by boiling the base with acetic acid for several hours, crystallises in white needles, melting at 164° and boiling above 360°; insoluble in cold water.

Acetylnitrocumidine—$C_6H(CH_3)_3(NO_2).NHAc$—is formed by nitration of the preceding body in acetic acid solution. It crystallises from alcohol in fine white needles of melting-point 204°; insoluble in cold water.

Acetyldinitrocumidine—$C_6(CH_3)_3(NO_2)_2.NHAc$[1:3:4:2:5:6]—is obtained by further nitration of either of the two preceding bodies with a mixture of 6 vols. of fuming HNO_3 and $1\frac{1}{2}$ vol. of H_2SO_4. It melts at 280°, sublimes undecomposed, and is insoluble in water; sparingly soluble in other solvents. On saponification it gives—

Dinitrocumidine—$C_6(CH_3)_3(NO_2)_2.NH_2$[1:3:4:2:5:6]—crystallises from alcohol in long orange-yellow needles of melting-point 183°.—A. G. G.

A New Cumidine. W. Engel. Ber. **18**, 2229—2233.

Commercial cumidine, obtained by heating xylidine-hydrochloride with methyl alcohol for twenty-four hours at 250° C. under a pressure of 20 atmospheres, was treated with HCl, the solid hydrochloride was pressed, treated with an alkali, distilled with steam and fractionated; the fraction 225—227° was boiled for twelve hours with acetic acid, and the acetyl derivative recrystallised from water until it had the melting point 112°. By saponification of this acetyl derivative the new cumidine $C_6H_2(CH_3)_3NH_2$ was obtained. It can also be isolated by directly acetylating the crude cumidine and crystal-

lising the acetyl derivative. It boils at 224°. The hydrochloride forms white needles easily soluble in water, nearly insoluble in strong HCl; the nitrate is less soluble than the sulphate. The following bodies were prepared from the new cumidine by the ordinary methods :—

Cuminol—$C_6H_2(CH_3)_3.OH$—oily fluid, boiling at 217°.

Acetyl-nitro-cumidine—$C_6H(CH_3)_3(NO_2)(NH\bar{A}c)$—yellow needles of melting point 121°.

Acetyl-di-nitro-cumidine—$C_6(CH_3)_3(NO_2)_2NHAc)$—nearly colourless needles, insoluble in water, melting at 204°.

Mono-cumyl-urea—$NH_2.CO.NH.C_6H_2(CH_3)_3$—white needles, insoluble in water.

Di-cumyl-urea—$CO[NH.C_6H_2(CH_3)_3]_2$—white needles melting above 290°.

Di-cumyl-thio-urea—$CS[NH.C_6H_2(CH_3)_3]_2$—prismatic crystals, insoluble in water, melting point 146°.—A. G. G.

Action of Acetone on Aniline. C. Engler and P. Riehm. Ber. **18**, 2245—2249.

The authors find that the base ($C_{11}H_{11}N$) which is produced by heating aniline hydrochloride with acetone (with or without a condensing agent) is formed more readily by heating aniline hydrochloride with mesityl oxide at 130°. CH_4 is evolved in both reactions, and the authors consider that the base is a (Py. 1 : 3)-dimethyl-quinoline :—

$$C_6H_4\begin{cases} C(CH_3) : CH \\ \qquad\qquad | \\ N \text{———} C(CH_3). \end{cases}$$

It is a colourless fluid of boiling point 264° uncorr. The *hydrochloride* (B'HCl) sublimes in flat needles easily soluble in water and alcohol. The *acid sulphate* ($B'H_2SO_4$) forms soluble needles melting at about 227°. The *chromate* ($B'_2H_2Cr_2O_7$) forms long orange needles, easily soluble in hot water, very sparingly in cold. A similar base is formed by heating aniline hydrochloride with acetophenone.—A. G. G.

The Relation of Diazobenzene-anilide to Amidoazobenzene. R. J. Friswell and A. G. Green. J. Chem. Soc. (Trans.), December, 1885, 917-924.

Amidoazobenzene, an isomer of diazobenzene-anilide, is usually prepared by allowing the latter body to remain in contact with aniline hydrochloride in solution, either in aniline, which is the most usual process, or occasionally in alcohol.

The change has been considered by Kekulé and others to be due to a double decomposition; but according to Griess, who discovered both bodies, the anilide is formed at a low temperature by the action of nitrous gas upon aniline, and the amido-compound by the same reagent at a high temperature.

The authors have endeavoured to obtain amidoazobenzene directly from aniline or its salts, but no matter how the experiments were varied as to temperature, acidity, concentration, solvent, order of mixture, and mass of reacting materials, they found that diazobenzene-anilide was formed first, even where, being in the presence of a quantity of aniline salt and in a hot solution, it rapidly changed into the amidoazo-compound.

They have discovered that treatment of diazobenzene-anilide with weak hydrochloric acid, causes the change, even in the absence of aniline hydrochloride; but they have also found that both this acid and dilute nitric acid have the power of resolving the anilide into diazobenzene and aniline chlorides; and they have observed that such mixtures by lapse of time combined again into amidoazobenzene, though if the acid were neutralised so as to cause a quick union the anilide was regenerated. From these and other facts detailed in the paper, it is inferred that neither is the isomeric change a double decomposition, nor is it due to coercive action of the acid tending to the development of a basic from an indifferent body—strong acids such as oxalic and sulphuric being unable to produce the change. On the other hand, all the evidence points to *time* as being absolutely essential for the rearrangement of the molecule. At the same time, they are unable at present to account for the remarkable fact that amidoazobenzene can only result from a second stage reaction. It is apparently *necessary* for the union to take place, so as to form the anilide; this body having been formed, slowly decomposes into diazobenzene and aniline, which then *slowly* only react, forming amidoazobenzene. If their reunion is hastened the anilide is simply reformed.

The resolution of the anilide and the presence of the products in the solution, account for the various decomposition products noticed as accompanying the formation of amidoazobenzene.

A similar isomeric change produced by an acid has been described by Wallach and Belli in the transformation of azoxybenzene into oxyazobenzene by means of sulphuric acid. This change the authors think will probably prove to be analogous to the one now discussed, and agreeing with V. Meyer's opinion as to the necessity for a symmetrical formula for diazobenzene-anilide, they think that one formed on the type of the azoxybenzene formula to be open to little or no objection, thus :

$$C_6H_5.N—N.C_6H_5 \qquad C_6H_5.N—N.C_6H_5$$
$$NH \qquad\qquad\qquad O$$

—W. S.

Compounds of Thiophen. O. Stadler. Ber. **18**, 2316.

Thiophenine hydrochloride is obtained by precipitating the tin double salt (*Ber.* **18**, 1490) with H_2S (this Journal, iv. 583). On spontaneous evaporation in vacuo over H_2SO_4, a white crystalline salt is deposited. The action of acetyl chloride on the above salt produces a coloured mass possessing the metallic copper appearance of certain aniline colours. The product could not be purified. Diazobenzene chloride acts on thiophenine hydrochloride in a concentrated aqueous solution and a yellow crystalline precipitate is formed. The compound is an azo-body of the formula :—

$$C_6H_5—N=N—C_4SH_2.NH_2,HCl+\tfrac{1}{2}H^2O.$$

With α-diazonaphthalene an analogous compound is formed which dyes silk a fast colour. With diazobenzenesulphonic acid a colouring matter is at once formed It separates out in the form of yellow needles and colours silk yellow. The above reactions show that thiophenine unlike aniline forms preferably, not diazoamido, but azo-compounds.

Nitro-Thienol:—One gram. of the above tin double-salt is dissolved in 150cc. water and the tin precipitated with 5cc. of dilute sulphuric acid. The filtrate cooled with ice is treated with the equivalent quantity of KNO_2. The mass is finally heated on the water-bath and then extracted with ether. The etheral solution, on evaporation, leaves a yellow crystalline mass, which on recrystallisation melts at 115—116°, and is similar in appearance to paranitrophenol, dissolving in alkalis with a yellow colour. It has the formula :—

$$C_4SH_2(OH)(NO_2).$$

An attempt to prepare a dimethyl thiophenine by the action of methyl alcohol on the hydrochloride of thiophenine resulted in the production of methyl mercaptan. —J. B. C.

On the Formation of Ortho- and Paranitrocinnamaldehyde. L. Diehl and A. Einhorn. Ber. **18**, 2335—2338.

The authors have prepared orthonitrocinnamaldehyde by the method described by Kinkelin for the corresponding meta compound (*Ber.* 18, 483); but the yield was only 40 per cent. of the calculated amount, while by the method of Baeyer and Drewsen 70 per cent. were obtained. Following Kinkelin's directions 50grms. of orthonitrobenzaldehyde were dissolved in 800grms. of alcohol; to the solution 1500grms. of water were added, and about 16grms. of acetaldehyde. 30grms. of 10 per cent. caustic soda were gradually added, the liquid never being allowed to become alkaline. After several hours about 5grms. more caustic soda were added.

The greater part of the orthonitrocinnamaldehyde separated out, and the mother liquor after filtration was treated with sodium chloride and extracted with ether. On boiling the residue from the evaporation of the etheric extract with acetic anhydride, more orthonitrocinnamaldehyde was obtained. The purified product crystallised in needles melting at 127—127·5°. The authors have succeeded in preparing ortho- and paranitrocinnamaldehyde by the direct nitration of commercial cinnamaldehyde. To a mixture of 500grms. of concentrated sulphuric acid and 20grms. of potassium nitrate, 25grms. of cinnamaldehyde are added drop by drop, the mixture being kept moderately cool. When the liquid is poured into water the two nitro-compounds separate in flakes, and may be recrystallised from hot alcohol. The separation is best effected by means of the acid sulphites which are formed by the addition of an equal volume of a solution of sodium bisulphite to the hot alcoholic solution of the nitro compounds, the mixture being allowed to cool at once. The greater part of the para-compound separates at once, and the remainder is precipitated by the addition of much sodium chloride. After twelve hours the mixture is filtered when the filtrate contains only the ortho-compound. The para-compound is dissolved in water and treated with concentrated sulphuric acid, when most of the nitrocinnamaldehyde is precipitated in flakes, the remainder being extracted with benzene. The pure product crystallises in almost colourless needles melting at 141—142°. The composition was confirmed by analysis. When a solution of the aldehyde in acetic acid is treated with phenylhydrazine an orange-red crystalline product is obtained, melting at 180—181°. The para-compound, dissolved in dilute alcohol, is easily reduced by ferrous sulphate and ammonia. The filtrate is extracted with ether, which on evaporation leaves a brown-red body possessing metallic lustre, and dissolving in sulphuric acid to form a fuchsin-red solution. The ortho-compound is separated and purified in the same way, and forms fine needles, melting at 127—127·5°. The phenylhydrazine compound forms Bordeaux-coloured needles which melt at 157·5°.—S. Y.

New Method for Preparing Tribenzylamine. R. Leuckart. Ber. **18**, 2341—2344.

Roth has prepared benzylidenediacetimide by the action of benzaldehyde on acetamide. With formamide the reaction proceeds otherwise. If benzaldehyde be heated with rather more than an equal weight of formamide or ammonium formate on the oil bath, when the temperature reaches 180° a reaction begins with evolution of ammonium carbonate, and a solid body slowly separates out. After heating for several hours the mass is filtered, washed with water and dilute NaOH, and then boiled with alcohol or extracted with ether. The basic products dissolve and a white crystalline substance remains behind, which has not been further studied. The ethereal solution on evaporation and addition of alcohol, crystallises in white plates. This body has the formula $C_{21}H_{21}N$ m.p. 91°. It forms a hydrochloride and a double platinum salt, and is identical in its properties with tribenzylamine. The yield amounts to 50 per cent. of the benzaldehyde used.—J. B. C.

Metadinitro-azoxybenzene and o-Azoxytoluene. H. Klinger and R. Pitschke. Ber. **18**, 2551—2556.

m-Di-nitro-azoxy-benzene, $\begin{matrix} C_6H_4(NO_2)-N \\ C_6H_4(NO_2)-N \end{matrix}\!\!>O$

was obtained by adding a solution of 2½ parts of *m*-di-nitro-benzene in 15 parts of methyl alcohol to a solution of sodium methylate obtained by dissolving one part of sodium in twenty pints of methyl alcohol. After recrystallisation it forms long light yellow needles of melting-point 142°, very sparingly soluble in cold alcohol, easily soluble in benzene.

By heating with strong H_2SO_4 it is converted into the isomeric body di-nitro-hydroxy-azo-benzene,

$$C_6H_4(NO_2)-N_2-C_6H_3(NO_2)OH,$$

which forms yellow crystals of melting point 173°, soluble in alkalis.

o-Azoxy-toluene $\underset{\textstyle\diagdown\!\!\diagup \atop O}{C_6H_4(CH_3)-N-N-C_6H_4(CH_3)}$ was prepared by adding ten parts of *o*-nitro-toluene to a solution of five parts of sodium in fifty parts of methyl alcohol, the mixture being finally heated on a water-bath for three or four hours to complete the reaction. The azoxy-toluene forms light yellow needles, plates, or tables, melting at 60°. On distillation with iron-powder it yields *o*-azo-toluene and a little *o*-toluidine. Strong H_2SO_4 converts it into *o*-azo-toluene and an acid compound.—A. G. G.

Condensation Products of Isatin. A. Baeyer and M. J. Lazarus. Ber. **18**, 2637—2643.

Indophenin, the condensation product of isatin and thiophen, has been again prepared and analysed by the authors as well as dibromindophenin from dibromisatin. The former body has the formula $C_{12}H_5Br_2NOS$. Although pure benzene has no action on isatin in presence of strong sulphuric acid, toluene reacts, at once forming a condensation product of the formula $C_{22}H_{19}NO$. The authors consider this compound to be a derivative of pseudo-isatin from its analogy with oxindol:

$$\begin{array}{ccc} C_6H_4-CH_2 & \text{oxindol,} & C_6H_4-C(C_7H_7)_2 \text{ toluisatin.} \\ | \qquad\quad | & & | \qquad\quad | \\ NH-CO & & NH-CO \end{array}$$

Isatin readily forms condensation products with phenols in presence of sulphuric acid, whereby the two H atoms in oxindol are replaced by two phenol groups. In this way phenol- and anisol-isatin have been prepared. Isatin also combines with tertiary bases, such as dimethylaniline to form dimethylaniline-isatin. These products may also be graphically represented as derivatives of triphenylmethane, from which the analogy with rosaniline and aurin is apparent:

$$C\begin{cases}(C_7H_7)_2 \text{ toluisatin,} \\ C_6H_4.NH \end{cases} \quad C\begin{cases}(C_6H_4OH)_2 \text{ phenolisatin,} \\ C_6H_4NH \end{cases}$$
$$| \qquad\qquad | \qquad\qquad\qquad | \qquad\qquad |$$
$$CO\text{———} \qquad\qquad\qquad CO\text{———}$$

$$C\begin{cases}[C_6H_4N(CH_3)_2]_2 \text{ dimethylaniline-isatin.} \\ C_6H_4NH \end{cases}$$
$$| \qquad\qquad |$$
$$CO\text{———}$$

—J. B. C.

Paraxylidine. E. Nölting, O. N. Witt, and S. Forel. Ber. **18**, 2664—2668.

The authors have isolated from commercial xylidine, which was supposed to consist principally of the meta-compound, about twenty-five per cent. of paraxylidine. The method of preparation is as follows: Commercial xylidine is treated with fuming sulphuric acid, and converted thereby into the sulphonic acid. On pouring the cooled mass into water, meta-xylidine separates out as a crystalline mass. The mother liquor is neutralised with lime, and the lime salt converted into sodium xylidinesulphonate. On distillation the salt yields, with very slight loss by decomposition, pure *p*.xylidine. It boils at 212—212·5°. The constitution of this body was determined by converting it into the diazo-compound, and finally into iodoxylene, from which by reduction with sodium amalgam a xylene was obtained, yielding on oxidation terephthalic acid. A number of its derivatives have been prepared. By nitrifying the acetyl compound nitroxylidine is obtained, which on reduction gives xylenediamine. The properties of this body pronounce it a paradiamine. On oxidation it yields para-xyloquinone (phlorone). If nitro *p*-xylidine be treated with ethyl-nitrite in the usual way, instead of the nitro-hydrocarbon, the ethyl ether is obtained. The diazo-compound of the para-xylidine mentioned above combines with phenols and amines to form beautifully crystalline *azo* colouring matters. The authors find that the average sample of commercial xylidine contains twenty-five per cent. of the para-compound, which implies also that commercial xylene contains a larger percentage of para-xylene than hitherto admitted.

—J. B. C.

*The Six Isomeric Xylidines.** E. Nölting and S. Forel. Ber. **18**, 2668—2681.

Ortho-xylidines. By the nitrification of *o*-xylene a nitro-xylene is obtained, distilling between 225° and 255°, about forty per cent. boiling at 245—247°. This fraction does not crystallise on cooling below 0°. On reduction it yields an amido-compound, which is purified by recrystallising the acetyl derivative from benzene. The fraction of the nitro-xylene boiling above 247° solidifies on cooling, and has a melting point 29—30°. It is therefore identical with Jacobsen's product (Ber. **17**, 159); *o*-xylene, like toluene, therefore, yields two mononitro-derivatives—the one a liquid, the other a solid. According to Jacobsen, the solid *o*-nitro-compound has the constitution $Ph(CH_3)_2NO_2[CH_3 : CH_3 : NO_2 = 1 : 2 : 4]$, and the liquid must therefore be $Ph(CH_3)_2NO_2[CH_3 : CH_3 : NO_2 = 1 : 2 : 3]$.

v-o-xylidine, obtained by reducing the liquid nitro-xylene, yields on oxidation xyloquinone, and the latter by reduction xyloquinol. By means of the diazo reaction *o*-xylenol has been obtained.

Meta-xylidines. The three isomeric *m*-xylidines have been prepared, the *a*-compound $Ph(CH_3)_2NH_2[CH_3 : CH_3 : NH_2 = 1 : 3 : 5]$ from commercial xylidine by recrystallising the hydrochloride and again the acetyl derivative. The other two isomers have been obtained by Wroblewski and Schmitz, the *s*-compound from nitro-xylidine $Ph(CH_3)_2NH_2NO_2[CH_3 : CH_3 : NO_2 = 1 : 3 : 5]$ by eliminating the amido-group, the *v-m*-xylidine by distilling amido-mesitic acid with lime. To prepare pure *m*-xylene from the commercial product, it is partially oxidised with nitric acid, which first attacks any *p*-xylene present. On nitrification 68 per cent. of mononitro-*m*-xylene was obtained, boiling between 215° and 241°.

The fraction 215—239° was refractionated. All the fractions thus obtained gave, on reduction, the same base, boiling at 209—213°. This *v-m*-xylidine may be purified by converting it into the acetyl derivative, recrystallising and decomposing the product with HCl in sealed tubes. It then boils at 214° under 739mm. pressure.

a-m-xylidine was prepared from the fraction of nitro-*m*-xylene boiling above 239°. It is the chief product in commercial xylidine. The acetyl derivative melts at 129°. This melting point is considered by the authors as the best criterion of the purity of the base.

s-m-xylidine. This compound was obtained by Wroblewski's method. The acetyl derivative of *a-m*-xylidine is nitrified, and after saponification the compound of the formula, $Ph(CH_3)_2NH_2NO_2[CH_3 : CH_3 : NH_2 : NO_2 = 1 : 3 : 4 : 5]$ obtained. By the diazo reaction, the amido group is then eliminated. *s-m*-xylidine yields on nitrification *p*-nitro-*s-m*-xylidine, $Ph(CH_3)_2NH_2NO_2[CH_3 : CH_3 : NH_2 : NO_2 = 1 : 3 : 5 : 4]$.

Para-xylidine is obtained by nitrifying *p*-xylene, and reducing the nitro body thus produced with iron and acetic acid.

By heating the different xylidine hydrochlorides with methyl alcohol in sealed tubes to 300—320°, a number of isomeric cumidines have been obtained. This portion of the subject has not yet been completed.—J. B. C.

The Manufacture of New Colour-yielding Products, and of Colouring Matters therefrom. Drs. Leo Gans and Meinhard Hoffmann, Frankfort-on-the-Main, Germany. Eng. Pat. 816, January 5, 1884.

This is an amendment of the former patent, No. 816 of 1884, the chief alteration being the statement referring to the nature of the by-products obtained by heating β-naphthylsulphonic acid with sulphuric acid to 60° C. for thirty-six hours. The chief product is, as formerly claimed, β-napthol-γ-disulphonic acid, but the by-product is not as stated in the previous specification, chiefly Schäffer's monosulphonic acid, since on a large scale a mixture of sulphonic acid is formed.—R. M.

* *v*=adjacent, *s*=symmetrical, *a*=asymmetrical.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Process and Apparatus for Treating Textile Materials with Liquids or Gases. H. J. Haddan. From Brandt and v. Nawrocki, Agents for C. Wetser, Thunn, Alsace. Eng. Pat. 15,654, November 27, 1884.

This patent relates to a process and apparatus for scouring, bleaching, or dyeing all kinds of textile materials at any stage of manufacture, whether yarns, cops, or woven goods, by subjecting them in hermetically closed vessels to the action of hot or cold liquids under direct pressure in combination with—

(*a.*) A continuous or intermittent circulation of the liquid.

(*b.*) A vacuum produced in the apparatus.

(*c.*) A vacuum produced in the apparatus in conjunction with continuous or intermittent circulation of the liquid.

The patentee recommends different forms of apparatus, of which he gives drawings, for the different materials to be treated. The cops, if required, can be scoured, bleached and dyed without being removed from the apparatus, or being dried between the operations, by means of an ingenious arrangement of mounting them on hollow spindles inside the vessels.—J. H. H.

Improvements in Machines for the Washing, Cleansing, and Scouring of Wool and other Fibrous Material. John Petrie and Frederick William Petrie. Eng. Pat. 1519, February 4, 1885.

This invention relates to an apparatus for the continuous application of the detergent solution employed for scouring wool or other fibrous material. It consists of a tank to collect the excess of liquid expressed from the material by means of the squeezing rolls ordinarily employed in cleaning wool. The tank is furnished with a float, attached to which is a rod fitted with two adjustable collars. The whole is arranged in such a way that on the rising of the float one of the collars acts on a lever connected with a steam injector, thereby causing the latter to raise the liquor in the tank and return it to the squeezing rolls. When in this way the level of the liquor in the tank is lowered, the other collar shuts off the steam from the injector. The supply of liquor to the squeezing rolls is thus made automatic.—E. J. B.

Improvements relating to the Waterproofing and Preservation of Linen and other Fabrics, Ropes, Hose, and other Articles composed of Vegetable Substances. H. H. Lake. From A. Sandron, Menin, Belgium. Eng. Pat. 6509, May 28, 1885.

The inventor first steeps his linen or other goods in a solution of chestnut extract—or extract of other substance rich in tannin—at from 1½° to 3° Tw. When the fabric is thoroughly saturated it is dried, and is then immersed in a second bath, consisting of twelve parts each of a pigment—as required—and of boiled linseed oil; two parts of birch-bark tar; and one part of palm-wax. This bath is maintained at a temperature of 100—120° C. (230° F.), and the goods on emerging from it are passed between squeeze rollers to remove excess of liquid. A further quick passage through a bath of cold boiled linseed oil gives the goods a better appearance. The inventor claims that goods so treated are impermeable and imputrescible, neither sticky nor brittle, and that the original good qualities of the material are not impaired.—J. H. H.

Process for Scouring Wool. Charles Toppan. Eng. Pat. July 28, 1885. Complete Specification.

The inventor claims the use of a solution prepared by dissolving together in water, mustard-seed oil, petroleum or other mineral oils, and alkali. Wool scoured by this solution is more pliable, has greater strength, and can be more finely spun than wool prepared by the ordinary methods.—E. J. B.

An Improved Waterproof Cloth. W. H. Slade. Eng. Pat. 10,554, September 7, 1885.

THE only novelty in this patent is the use of a "one-sided Terry cloth" for waterproofing. There is nothing new in the manner of applying the waterproofing substance, and the inventor does not state its composition. —J. H. H.

Improvements in Obtaining and Treating Fibres from the Barks of Plants of the Urtica family, and the like. G. F. Redfern. From Prof. C. Frémy and V. Urbain, Paris. Eng. Pat. 11,660, September 30, 1885.

THE inventors state that to the presence of lime—of which there is from three to eight per cent. in the outer covering of the plant—is due the brittleness and absence of gloss which is a frequent cause of depreciation in the value of the fabrics obtained from plants of the Urtica (nettle, rhea, etc.) family, and the like. To eliminate this, the bark of the plants is detached from the woody portion—preferably by Favier's process (Eng. Pat. 1609, 1880)—and then steeped for one day in a cold solution of HCl at 3° Tw., which is the distinctive feature of the process. It is then washed thoroughly, and boiled in kiers at a pressure of three atmospheres with a solution of caustic soda at 2° Tw. This operation may be repeated if necessary, and the fibre is next washed and again soaked in HCl at 3° Tw. for fifteen minutes; then washed again and heated for three hours in the kier, with a solution containing 1lb. of caustic soda and 9½oz. of oleic acid to every ten gallons of water. The inventors claim that by this process all the lime is removed, and the fabric sufficiently bleached, without the use and deteriorating influence of bleaching powder.—J. H. H.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in the Apparatus to be used in Bleaching Fabrics and Yarns. William Mather. Eng. Pat. 16,663, December 19, 1884.

THE object of this invention is to facilitate and accelerate the operation of bleaching as performed by the Thompson process. The apparatus consists of a cylindrical bleaching kier, connected by means of a three-way cock with a pump, a tank for holding liquor, and a gas-holder containing carbonic acid gas. The kier is furnished with a cover fitting into an annular space filled with water, thus ensuring a perfectly gas-tight joint. By the simple manipulations of the three-way cock, the kier can be successively filled either with bleach liquor or with gas.—E. J. B.

Improvements in the Extraction of Extraneous Matters from and in Bleaching Vegetable Fibres. Jonathan Smith and Philip Winter Nicholle. Eng. Pat. 17,083, December 31, 1884.

THIS process consists in treating fibres, such as China-grass, manilla, etc., with a solution of an alkaline sulphate, either hot or cold. The fibre is then washed, soaked in a weak acid solution, and finally bleached with a solution prepared by decomposing chloride of lime with sulphate of potash.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Occurrence of Springs containing Carbon Dioxide, and the Preparation of Liquid Carbonic Acid at Burgbrohl. Abstract of a paper read by Mr. Heusler at the meeting of the Society of Natural History and Medicine at Bonn.

SOME time ago a shaft 52 metres deep was sunk at Burgbrohl, and at Hoenningen on the Rhine, from which considerable quantities of carbon dioxide and water saturated with that gas, may be obtained. Measurements recently taken showed that the bore-hole yielded 430 litres of water and 1500 litres of carbon dioxide per minute, equal to 2160 cubic metres per twenty-four hours. As soon as it was proved that a permanent supply of gas could be expected, a factory for compressing the carbon dioxide evolved was started, and has been working for the last six months. The apparatus consists of a boiler and steam-engine. The engine works two gas-compressers, whence the compressed carbon dioxide is passed into a worm lying in cold water. Wrought-iron cylinders are screwed to the worm, and serve to receive the liquid carbonic acid. 500 litres of carbon dioxide yield 1 litre of liquid carbon dioxide, weighing 1 kilo. The pressure necessary for the compression is equal to 49 atmospheres at 13° C., or to 60 atmospheres at 21·5° C. The cylindrical bottles serving for the conveyance of the finished product hold 8 litres or 8 kilos. each, and are tested for a pressure of 250 atmospheres. Explosions of bottles occur very rarely. They are not dangerous either, as the material cracks without flying asunder, thus only causing a vehement evolution of gas. The explosions would become dangerous only under special circumstances; for instance, if the bottles became warm or hot, which circumstance would cause an enormous increase of the pressure; for whereas air expands for a rise of temperature from 0° to 30° C., by 0·109 of its volume, liquid carbonic acid increases its volume four times as much, or 0·423 of its volume. This curious property of liquid carbonic acid has been applied in practice for the compression of steel and other metal castings. At Krupp's steel works at Essen the enormous pressure of 1200 atmospheres has been reached when heating liquid carbonic acid to 200° C.—S. H.

The Decomposition of Potassium Chlorate by Heat. Frank L. Teed. Proc. Chem. Soc., November, 1885.

BY heating potassium chlorate till it had lost varying amounts of oxygen, determining that oxygen from the loss in weight, and determining the potassium chloride produced by means of a decinormal silver nitrate solution, using potassium chromate as indicator, the author has come to the conclusion that potassium chlorate decomposes according to the equation:

$$10KClO_3 = 6KClO_4 + 4KCl + 3O_2.$$

The equation indicates that for every 74·5 parts of potassium chloride produced, there should be 24 parts of oxygen evolved; also that when potassium chlorate shall have yielded 7·84 per cent. of oxygen, all the chlorate is decomposed, and nothing but perchlorate and chloride are left.

The equation $2KClO_3 = KClO_4 + KCl + O_2$, by which the decomposition is ordinarily expressed, requires 32 parts of oxygen to every 74·5 of potassium chloride, and would not be complete till 13·06 per cent. of the oxygen had been evolved.

The following are results obtained:—

Amount of $KClO_3$ taken. Grams.	Oxygen lost, per cent.	Potassium Chloride formed, per cent.	Amount of Oxygen to 74·5 of KCl.
3·2515	1·66	5·26	23·51
1·592	3·49	10·86	23·94
2·1725	6·00	18·25	24·49
3·956	10·52	27·36	28.65

The last experiment, in which 10·52 per cent. of oxygen was evolved, shows a much larger yield of oxygen to the 74·5 parts of potassium chloride, which is readily explainable by reference to the equation proposed. As mentioned above, the change represented by the equation is finished when 7·84 per cent. of oxygen is evolved, and 24·34 per cent. potassium chloride is produced. The remaining 2·68 per cent. of oxygen can only be produced by the decomposition of potassium perchlorate in accordance with the equation $KClO_4 = KCl + 2O_2$; from this it follows that 74·5 parts potassium chloride are produced for every 64 of oxygen, and hence that the

evolution of 2·68 of oxygen should be accompanied by the formation of 3·14 of potassium chloride. Therefore 10·52 of oxygen requires 24·34 + 3·14 = 27·48 of potassium chloride, a number agreeing fairly well with that found —27·36.

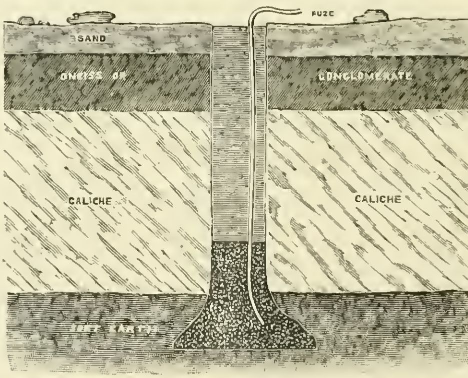
On treating some of the residue from the fourth experiment with sulphuric acid, only the faintest possible indication of a chlorate was obtained.

The author confirms the statement that no perchlorate is formed when potassium chlorate is heated with manganese binoxide, having found in one experiment—the only one made—a ratio of 74·5 of potassium chloride to 47·15 of oxygen (theory requiring 48), when the amount of oxygen evolved was only 3·38 per cent.

If potassium perchlorate be required in quantity, it would be considerably better to heat the chlorate till only 7·84 per cent. than till 13 per cent. of oxygen is evolved, as the equation $2KClO_3 = KClO_4 + KCl + O_2$ indicates a yield of 56·53 per cent. of perchlorate; the equation $10KClO_3 = 6KClO_4 + 4KCl + 3O_2$, a yield of 67·84 per cent.—W. S.

Machinery for the Manufacture of Nitrate of Soda. Robert Harvey. Proc. Inst. C.E., 1884—85. Part iv.

THE whole of the known nitrate deposits in the world are situated on the west coast of South America, between south latitude 19° and 27°, although there are indications of nitrate in Nevada and California. The "caliche," or raw nitrate of soda, is supposed to have originated from decomposing animal and vegetable matter in contact with salts left by the evaporation of sea-water, and this theory is supported by the frequent discovery of guano, feathers, shells, etc., in proximity to the caliche, and at a depth of 12 to 15 feet below the surface. The best deposits are found on the Tamarugal Pampa, in the province of Tarapacá, recently annexed by Chili. The caliche is found in beds from six inches to twelve feet thick, beneath a covering of conglomerate. No caliche bed is found nearer to the sea coast than 15 miles, and the furthest beds are distant 90 miles. The Ramirez caliche is plentiful and easy of extraction; it contains 51 per cent. nitrate of soda, 26 per cent. common salt, 6 per cent. sulphate of soda, 3 per cent. sulphate of magnesia, and 14 per cent. insoluble. The figure shows the position of the caliche in the ground, and the method of obtaining it. A shaft, about one foot in diameter, is sunk, into which a boy is lowered, who forms a cone-shaped recess in the earth at the bottom of the caliche, which is charged with a slow-blasting powder, and ignited by a fuse. This causes a dull explosion, loosening the ground around the shaft for a radius of ten yards. The production of nitrate of soda has been developed with great rapidity since 1869, only 6000 tons having been exported in 1845. The production increased by degrees up to 70,000 tons in 1859, and in 1883 the exportation reached 570,000 tons. Such a production would have created an excess over the demand, and the producers have since agreed to limit their out-put so as meet European requirements, which at present are 460,000 tons annually. The production of English Companies amounts to 40 per cent. of the whole. A description is given of the plant erected by the author at the Ramirez Factory, Northern Chili, of which the productive capacity is 6360 tons per month; but, like the other establishments, this factory is limited to 40 per cent. of its full capacity, and this gives an annual output of 30,000 tons. The plant comprises six steel boilers, twelve boiling tanks, ninety crystallising tanks, a five-compartment washing tank, three large circular tanks, and three crushing machines, as well as locomotives and rolling stock. Owing to the salt and other solvents contained in the soil, great care was bestowed in preparing the foundations for the carrying walls. The caliche is extracted according to the Shanks' lixiviating system, and when the solution is at 110° Tw. it is allowed to settle for a short time, and then is run off to the crystallisation tanks at a temperature of 240° F. The crystallised nitrate, after the mother-liquor has drained away, is transferred to drying floors, where it becomes perfectly dry in the topical sun, and it is then filled into sacks for export. The cost of the machinery, plant, and construction amounted to £110,000. For the night work, two 6000 candle-power arc lights are used. The paper is accompanied by drawings showing arrangement of plant.—G. H. B.



A New or Improved Method of Manufacturing the Fluoride, or Double Fluoride, of Aluminium with Sodium or Potassium. L. A. Groth, London. From R. Grätzel, Hanover. Eng. Pat. 156, January 5, 1885.

SOLUTIONS of 1 equivalent of aluminium chloride and 6 equivalents of an alkaline fluoride are mixed together. Aluminium fluoride is precipitated, and an alkaline chloride remains in solution. When a larger proportion of alkaline fluoride is present, the excess combines with the aluminium fluoride produced, to form a double fluoride. When a double fluoride of aluminium and an alkali metal, such as cryolite, is finely powdered and treated with aluminium chloride solution, the alkaline fluoride reacts as above, the aluminium fluoride remaining with the insoluble precipitate of the newly-formed like substance.—A. R. D.

Improvements relating to the Treatment of Alkaline Silicates and other Materials, and to the Formation of various Articles therefrom. W. R. Lake, London. From the Bowsilate Company, Limited, of Albany, New York. Eng. Pat. 5553, May 5, 1885.

To a filtered solution of alkaline silicate of 26° B., a solution of camphor in turpentine is added, and the

whole evaporated on a water-bath to such a consistency that when cold it can be ground to powder, and does not adhere to the dies in the process of moulding. The ground material is placed in dies or moulds of the usual construction, and subjected to a pressure of 2000lb. to the square inch, at a temperature of from 250° to 300° F. The articles, when taken from the mould, are polished, and then immersed in a bath of chloride of ammonium solution for from ten to fifteen hours, to correct the tendency of the material to effloresce. The turpentine may be omitted, and the silicate used either by itself or with the admixture of some suitable oxide, as zinc oxide, or inert colouring matter. In this case the articles should be subjected to the pressure of about 8000lb. per square inch. This material may be largely used as a substitute for ivory.—A. R. D.

Improvements in the Manufacture of Hydrates of Barium and Strontium. Hugh Lee Pattinson, jun., Felling-on-Tyne. Eng. Pat. 16,959, December 28, 1884.

To a solution of the sulphide, say of barium, oxide of manganese is added, and air is blown through the mixture. About 66 per cent. of the barium are converted into hydrate, and about 33 per cent. into insoluble hyposulphite. Also about 33 per cent. of the sulphur present are liberated and deposited. This sulphur is separated from the rest of the precipitate by a suitable solvent, preferably naphtha, and the oxide of manganese used to convert a fresh batch of sulphide solution. The impregnation with naphtha enables 80 per cent. of the barium to be converted into hydrate by checking the formation of hyposulphite. By a modification of the invention, air is blown into the mixture as above, only till a precipitate begins to form. At this point, two-thirds of the barium exists in the form of hydrate, and the remaining third, probably, as tersulphide. The clear liquor is allowed to crystallise, and yields almost pure barium hydrate; the mother-liquor is evaporated down, and the barium tersulphide so obtained is reduced to sulphide by any convenient process, and treated as above over again. During the blowing process, the temperature should be kept at about 100° F., and the formula $MnO_2 + BaS$ should represent the proportions of manganese and sulphide of barium used.—A. R. D.

X.—METALLURGY, Etc.

Progress of the Basic or Thomas-Gilchrist Process, for Twelve Months ending September 30, 1885.

The total make of steel and ingot iron made from phosphoric pig during this period amounts to 945,317 tons, being an increase over the make for the previous twelve months of about 10 per cent. It is noticeable that of this make no less than 600,183 tons was ingot iron containing under 0·18 per cent. of carbon, used for wire, sleepers, tin plates, tubes, boiler and ship plates, etc. The makes of the various countries are as follow:—

	Tons		Tons.	
England....	115,707	Of this	70,813	contained under ·18% carbon.
Germany and Austria	617,514	,,	424,862	,, ,, ,,
France......	130,582	,,	62,390	,, ,, ,,
Belgium and other Countries	51,514	,,	42,118	,, ,, ,,
Total....	945,317		600,183	Tons.

The Influence of Silicon on the Properties of Cast Iron: Part II. Thomas Turner. J. Chem. Soc. (Trans.), December, 1885, 902—916.

The paper is a continuation of one recently published (*Chem. Soc. Trans.*, 1885, 577, and this *Journal*, iv. (10), 595).

An account is given of experiments on the relative density, hardness, working qualities, and crushing strength of the metal, and the reason of the variations noticed is discussed.

The relative density was determined both in mass and in small fragments. In the first case, cylinders 3″ × 1″ were employed, and the turnings from the cylinders were used for a second determination. In iron possessing great tenacity, the density was slightly increased; but with less tenacity, the density was decreased by the force exerted in turning the metal. The hardness was measured by the weight in grams necessary to produce a scratch with a cutting diamond. The influence of silicon is shown to be quite regular, the greatest softness being produced by from 2 to 3 per cent. The working qualities are taken from the observation of a skilled workman, and agree very closely with the hardness as before determined. The crushing strength tests were performed by Prof. Kennedy on cylinders 3″ × 0·75″, and sketches are given of the fractured specimens. The influence is tolerably regular, and of the kind previously observed: the maximum value being reached with 1 per cent. of silicon.

Silicon per cent.	Relative density* of cylinders 3″ × 1″.	Relative density* of turnings from cylinders.	Relative hardness.	Crushing strength. Breaking load per sq. in.	
				Pounds.	Tons.
0	7·560	7·719	72	168,700	75·30
0·5	7·510	7·670	52	201,800	91·42
1	7·641	7·630	42	207,300	92·51
2	7·518	7·350	22	135,600	60·53
				139,000	62·05
2·5	7·422	7·388	22	172,900	77·18
3	7·258	7·279	22	128,700	57·45
4	7·183	7·218	27	106,900	47·71
5	7·167	7·170	32	103,100	46·16
7·5	7·128	7·138	42	111,000	49·55
10	6·978	6·924	57	76,380	34·10

* Water at 20° C. = 1.

In the above table a summary is given of the chief results.

The author draws the following conclusions from these results.

1. That a suitable small addition of silicon to cast-iron almost entirely free from silicon, is capable of producing a considerable improvement in the mechanical properties of the metal.

2. That in these experiments the maximum values are probably reached with the following amounts of silicon:

Crushing strength	about 0·80 per cent.
Modulus of elasticity..........	,, 1·00 ,,
Relative density (in mass)	,, 1·00 ,,
Tensile strength	,, 1·80 ,,
Softness and working qualities	,, 2·50 ,,

3. That when general strength is required the amount of silicon should not vary much from about 1·4 per cent.; but that when special softness and fluidity are desirable, about 2·5 per cent. may be added. Even in the latter case, however, any increase upon 3 per cent. must be dangerous.

These conclusions are only strictly true under the circumstances of the author's experiments, but he hopes shortly to bring forward evidence from independent investigations to support his results.

The cause of these results is discussed. The author is decidedly of the opinion that the production of graphitic carbon is not the only cause of these differences, but that in addition to the indirect effect owing to the production of grey iron, the suitable addition of silicon has a direct and beneficial influence upon the mechanical properties of the metal.—W. S.

Processes for the Treating of Metals, for their Coating and Insulating with Vitreous, Similar, and other Substances, and in heating and fusing by portable and manifold means upon such Metals and Materials. William Adolphus Biddell, Erdington, and Caroline Aris Biddell, Islington. Eng. Pat. 13,029, October 1, 1884.

THIS patent refers to means for coating iron or steel surfaces with vitreous enamels for various purposes and by various methods enumerated.—W. G. M.

Improvements in the Manufacture and Treatment of Self-hardening Steel. Robert Hadfield, Southampton Buildings, London. Eng. Pat. 16,049, December 6, 1884.

IRON or steel scrap, or wholly or partially decarburised pig iron, is melted with a proportion of ferro-manganese-silicon or spiegel in such proportions that the manganese is present in the resulting product to the extent of from 2½ to 7 per cent., the carbon being preferably kept low. To obtain the maximum hardness, 2½ to 5 per cent. of manganese should be present; for a less hard metal, from 5 to 7 per cent. This steel, which may be made containing only one-half per cent. of carbon, is less liable than ordinary steel to honey-combing and to slag impurities; and, although very hard in the cold, works mild, and when being reduced will bear with safety a higher temperature than that commonly employed; it is less expensive than tungsten and other self-hardening steels.—W. G. M.

A New or Improved Method of Plating Silver with Gold. John Millward Banks, Birmingham. Eng. Pat. 16,855, December 23, 1884.

TWO plates of silver and gold respectively, of equal size and of thicknesses proportional to those ultimately required (*e.g.*, for jewellery ornaments, the plates might be 8 inches long by 4 inches wide, the sheet of silver being nineteen times thicker than that of gold) are rendered perfectly flat and absolutely clean. They are then placed in intimate contact between two somewhat larger plates of iron clamped together by binding with wire at the projecting edges. The whole mass is then heated to a bright red heat in a muffle containing pieces of coke, to prevent oxidation of the iron plates, and is then submitted to powerful pressure in a suitable press with flat bed plate; the object being merely to unite the faces of the heated metals. It is then raised carefully to a temperature approaching the fusing point of silver—a point indicated by the appearance of a bright line at the junction of the plates, or by the fusion of a suitable silver alloy placed in a cupel close to the mass. The compound plate may afterwards be rolled to any degree of fineness. —W. G. M.

An Improved Instrument or Apparatus for Indicating the Presence of Gas, being more particularly applicable for use in Coal Mines. John Della Bella, T. Chaloner, and W. Chaloner, all of Preston. Eng. Pat. 15,694, August 27, 1885.

A WEIGHTED bulb carrying an air vessel or balloon at the top of a vertical stem is made to float near the top of a column of water in a suitable vessel. The upward and downward movements of the bulb are intended to give indications of the quantity of "gas" present. Instead of this arrangement, the air balloon may be fixed at one end of an oscillating beam, the other end being provided with a sliding balance weight.—A. R. D.

A Method and Apparatus for Extracting Nickel and Cobalt from Ores containing them. Lorentz Albert Groth, London. From Demetry Mindeleff, San Francisco, U.S.A. Eng. Pat. 10,491, September 4, 1885.

THE ore in its rough state is heated to redness in a retort, through which is then passed a current of hydrocarbon gas until a sample of the resulting gases, passed through a solution of a lead or copper salt, gives no black precipitate (indicating absence of hydrogen sulphide, and completion of the reduction). After passing from the retort, the arsenical and sulphuretted gases are water-washed, and returned to the gas-holder. The charge is next cooled in a reducing atmosphere, withdrawn, crushed, and transferred to a wooden tub; here it is kept in constant motion by means of revolving arms, and is submitted to the action of an electro-magnet. This electro-magnet is so actuated by the use of a cam and automatic contact breaker, that it is alternately plunged—the electric circuit being then complete—into the revolving ore, and then subjected to a first vertical and then lateral movement, accompanied by a break of conductive continuity, which thus permits the magnetic particles to fall from the magnet into the receptacle provided for them. In this manner all magnetic metallic particles are gradually removed from the ore tub to the receiving vessel, and may be subsequently treated as desired.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Fat from the Fruit of Myristica Surinamensis. C. L. Reimer and W. Will. Ber. **18**, 2011—2017.

THE fruit of the *myristica surinamensis*, imported into Germany under the name of "oil-nut," has been the subject of a very complete analysis by the authors. The nuts have the size and form of a cherry, with a dark grey brittle shell enclosing a hard kernel. The kernels freed from shell were ground to powder and extracted with ether; 73 per cent dissolves, and the residue forms a reddish mass, which has not been further examined. The crude fat contains resin and a free acid. The amounts of these were determined by dissolving the crude product in petroleum spirit, which leaves the resin undissolved. The latter amounts to 6·6 per cent. of the crude fat. The petroleum solution was treated with dilute soda solution, and the alkaline liquid separated and acidified, and then extracted with ether. The ethereal solution left a residue of 6·5 per cent.; 100 parts of crude fat contain therefore 87 parts of pure substance. The pure fat has the formula $C_{45}H_{86}O_6$, which agrees with that of trimyristin. Like tristearin and tripalmitin, this body exists in different modifications with different melting points. To determine further the composition of the trimyristin, it was saponified with alcoholic potash, by which means an acid of the composition $C_{14}H_{28}O_2$, or myristic acid, is formed. No other glycerides exist in this fat. The free acid in the crude fat was found to be myristic acid. Owing to the purity of the fat, and the absence of other glycerides, the author recommends it as a source of pure myristic acid.—J. B. C.

Detection of Fat Oils in Mineral Oils. F. Lux. Zeits. Anal. Chem. 1885, 357.

IN cases where the proportion of the former is large (10 per cent.) it suffices to boil the oil (5cc.) for two

minutes with fragments of sodium hydrate. Saponification is indicated by the smell and by the solidification of the liquid on cooling. For the detection of smaller proportions the test must be more carefully carried out. Small quantities are heated both with metallic sodium and sodium hydrate at 200—210° in test tubes placed in a paraffin bath. After heating for fifteen minutes, the tubes are removed and allowed to cool. The presence of a fat oil—*i.e.*, a soap, is indicated by the solidification (gelatinisation) of the contents of one or other, or both tubes.—C. F. C.

Improvements in the Distillation of Fatty Substances and the like, by means of Superheated Steam and Apparatus therefor. W. P. Thompson. From M. Julien and M. Blunoski, Odessa. Eng. Pat. 14,700, November 7, 1884.

A CYLINDRICAL boiler, provided with domes, connected with condensers, is traversed by a long series of pipes for superheated steam, which finally issues into the contents of the boiler by perforations in the last coil. Apparently no external fire is used in the distillation.
—W. L. C.

An Improved Disinfecting Compound and Soap. John Jeyes. Eng. Pat. 16,427, December 13, 1884.

GAS-TAR is distilled and the light oil rejected; 16 parts of the heavier oil, 32 parts of cocoa-nut oil, and 16 parts caustic soda at 35° Baumé, are saponified in a jacketed pan, with or without the addition of rosin and sodium sulphate and carbonate.—W. L. C.

An Improved Manufacture of a Detergent. W. Needham. Eng. Pat. 16,490, December 15, 1884.

SOAP-PASTE, while hot, is mixed with one-half its weight of magnesia mica, a bye-product in the washing of china clay.—W. L. C.

An Improved Cleansing Compound. F. J. Harrison. Eng. Pat. 16,847, December 23, 1884.

TWO tons of soap are dissolved in 500 gallons of water; 6 tons of "pure alkali" are added, and water enough to keep the whole at the consistency of cream; with this are mixed 8 cwt. of muriate of ammonia with which has been incorporated 8 gallons of hydrogen peroxide. For the latter, 5 per cent. on the whole bulk, of chloride of soda, is sometimes substituted.—W. L. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Process for Purifying Vegetable Tannin Extracts. Jules Doutreleau. Eng. Pat. 14,561, November 4, 1884.

THE process consists in boiling the extract with a sulphite, or hyposulphite, preferably the hyposulphite of alumina. A suitable proportion is 1 gramme per litre of extract of 2° B.—H. R. P.

Manufacture of Artificial Leather. Communication from H. Schwabacher, of Paris. Eng. Pat. 14,587, November 4, 1884.

A COTTON fabric is treated with a mixture of 5 parts of decoction of linseed, 4 parts of rabbit-skin glue, 1 part of boiled linseed oil, and a sufficiency of colouring matter. It is then dried on a polished zinc plate heated by steam.—H. R. P.

Improvements in Aluming or Curing Hides or Skins. Bertram Hunt. Eng. Pat. 15,607, November 27, 1884.

INSTEAD of using alum and salt, as is customary, the patentee employs a solution of a basic aluminic salt, prepared by adding sodic carbonate to a solution of alum, or aluminic sulphate, or chloride, or by dissolving freshly precipitated aluminic hydrate in it. A small quantity of salt is in some cases used. The use of basic salts of other metals is also claimed.—H. R. P.

Apparatus for Steeping, Liming, Baiting and Tanning Hides. Chas. Louis Royer. Eng. Pat. 15,827, December 2, 1884.

A VAT is provided with a vertical axis and radiating arms, to which the hides are attached. It is practically identical with the ordinary German Dreh-kalk.—H. R. P.

Improvements in the Production of Tanning and Dyeing Materials. Thos. Cobley. Eng. Pat. 408, January 18, 1885.

OAK-LEAVES, twigs, and other forest refuse, are cut up in a gorse-cutting machine, and exhausted to form a fluid extract; or dried, ground, and sifted, to form "oak-leaf sumac."—H. R. P.

Improvements in Artificial Leather. E. M. Freeley. Eng. Pat. 2158, February 17, 1885.

LEATHERETTE or rubber-cloth is treated with tanning infusions, and scented with Russian birch-oil *(juchten)* extract.—H. R. P.

An Improved Process for the Manufacture of Glazed Leather. Thos. R. Clark. Eng. Pat. 7915, June 30, 1885.

INSTEAD of tawing the skins with alum, salt, egg yolk, and flour, the skins are tawed or chamoised with oil. The oil is very carefully removed by repeated treatment with naphtha or mineral volatile oil, when the skins may be dyed and glazed in the usual way.—H. R. P.

XV.—SUGAR, GUMS, STARCHES, Etc.

Specific Rotation of Invert Sugar. O. Gubbe. Ber. 18, 2207—2219.

THE specific rotation of a solution of invert sugar depends not only upon the concentration and temperature, but also upon the nature and proportion of acid used for the inversion. In this paper experiments are detailed with a view of determining the effects produced by these several causes.

[I.] *Influence of Acid.*—In the case of sulphuric and hydrochloric acids, the specific rotation increases with proportion of the acid in accordance with the formula $[a]\frac{20^\circ}{D} = -(19{\cdot}983 + {\cdot}16979xH_2SO_4)$ or $-(19{\cdot}995 + {\cdot}3261xHCl)$ in which x is the proportion of acid to 10 parts invert sugar and 100 parts water, whereas the specific rotation is independent of the proportion of oxalic acid, which was accordingly used for the experiments described below.

[II.] *Influence of Concentration.*—From the experiments the following formula is deduced for solutions at 20° containing less than 35 per cent. sugar:—

$$[a]\frac{20^\circ}{D} = -23{\cdot}305 + 0{\cdot}01612q + {\cdot}0002239q^2;$$

beyond this degree of concentration, secondary decompositions, such as caramelisation, ensue, so that the curve expressing the specific rotation in terms of concentration is irregular.

[III.] *Influence of Temperature.*—The general formula deduced is $[a]\frac{D}{6} = a + bt + ct^2$, in which the constant a only is dependent upon the concentration, b and c on temperature. For solution at 0° to 30° C. the formula holds good:—$[a]\frac{t}{D} = -23{\cdot}305 + {\cdot}30406(t-20) + {\cdot}001654(t-20)^2$, and between 20° and 100°

$$[a]\frac{t}{D} = -23{\cdot}305 + {\cdot}32464(t-20) - {\cdot}0002105(t-20)^2.$$

The above results indicate that Clergel's formula for the determination of crude sugar by inversion is not exact, since there is not the simple proportionality between the differences of angle of rotation before and after inversion (D), and the quantity of sugar in 100cc. (3), as expressed by the formula $D = Az^2$, but rather on

account of the variation of specific rotation with concentration, the following formula is preferable, $D = Az + bz^2$.

Thus, if 19grm. of the sugar to be examined are dissolved in 100cc., the percentage, x, of pure sugar, can be calculated by means of the equation

$$D = \tfrac{19}{100}ax + (\tfrac{19}{100})^2bx^2 \text{ and } D = \cdot33143\,x + \cdot000023\,x^2$$
$$(e = \tfrac{19}{100}x);$$

an actual example is given of the application of these formulæ.—V. H. V.

Detection of Cane in Milk Sugar. Lorin. Pharm. Zeit. für Rußland. **17**, 372.

A MIXTURE of equal parts of milk sugar and oxalic acid melts when warmed upon the water bath, and becomes very faintly darker in tint. An addition of one per cent. of cane sugar causes the rapid development of a dark tint on heating, and with several per cent., the mass is rendered greenish-brown or black by this treatment. The serviceableness of this test is confirmed by Geissler. (Pharm. Cent. 1885, 244.)—W. D. B.

Improvement in the Method of and Apparatus for Boiling Sugar. F. B. Welch, Manchester. Eng. Pat. 500, January 14, 1885.

THE juice, which may be evaporated in an open pan or a vacuum pan, is kept constantly agitated, either by a mechanical contrivance, such as revolving blades or stirrers, or by the action of air passing through the juice.—A. J. K.

Process for the Purification and Decoloration of Saccharine Liquors, Juices, or Syrups. C. D. Abel. From La Société Nouvelle de Raffineries de Sucre de St. Louis-Marseilles. Eng. Pat. 2724, February 28, 1885.

OXIDES or salts of tin are applied in any of the following ways: (*a*) Introducing into the liquid stannous or stannic oxides previously prepared, boiling the mixture for some minutes and filtering; (*b*) introducing a salt of tin (stannous sulphate) along with a base, such as baryta (or barium carbonate), boiling for some minutes and filtering from the oxide of tin and the barium sulphate; (*c*) adding a salt of tin, boiling, neutralising the acid liberated from the salt by a base like lime, and filtering; (*d*) adding first a salt of an alkali or alkaline earth (such as $BaCO_3$), heating to boiling, and then adding a solution of a salt of tin in small successive quantities, and filtering.—W. S.

Improvements in the Manufacture of Starch Meal. W. R. Lake. From W. T. Jebb, U.S.A. Eng. Pat. 4954, April 21, 1885.

A KERNEL of Indian corn or maize consists of three principal parts—viz., the inner portion or body, which consists principally of starch cells; the outer enclosing skin or hull and its glutinous lining, which consist of wood fibre, nitrogenous compounds, albumen and oil, which are useful for cattle feed; and the germ, which is located at the small or cob-end of the kernel, and is very rich in oil, the latter forming about 70 per cent. of its constituent parts. To obtain the crude starch from the Indian corn various processes have hitherto been used—the wet "sour or fermentation" process, the wet "sweet" process, and sundry dry processes. These are described by the author, and the several objections to them are pointed out, such as the length of time, and large amount of water required, difficulty of obtaining a complete separation of the hull, gluten and oily germs from the starch, etc. The object of the present invention is to overcome these difficulties, and the process adopted is as follows:—

The maize is first steeped in a suitable tank at about 140° F. for about 15 hours. At the end of this time it is found that the starchy body of each kernel has become enlarged and soft, the germ has also swelled, and the hull become tough, and the three portions exhibit a tendency to separate from each other. Care must be taken that the temperature of the maize does not rise to 155° F., or the starch grains will burst, and render any subsequent separation difficult, if not impossible.

In order to effect the desired separation, cold water is first introduced into the steeping tank to cool down the mass, and when this is effected the water is drained off. When thoroughly drained, the maize is next subjected to the action of a reducing machine consisting, preferably, of several concentric rows of beaters or whippers revolving at high speed in opposite directions within an enclosing case. On emerging from here, the maize is found to consist of a mixture of finely pulverised starch, of entire oily germs, and of the husks which have been torn off in the form of large flakes; and the whole, moreover, is now in a sufficiently dry condition to enable the further separation to be proceeded with. This is effected by passing the "reduced" material over a vibrating screen. The upper portion of this screen consists of fine wire-gauze through which the finely-powdered starch passes, the lower portion of a coarser material through which pass the germs, whilst the hulls escape over the end. Each portion is collected in a separate receiver. The starch meal thus obtained may be further reduced by grinding in a "Bogardus" or other mill, and applied to the purpose for which it is required.—A. J. K.

Improved Starch Meal. W. R. Lake. From W. T. Jebb, U.S.A. Eng. Pat. 4948, April 21, 1885.

THIS patent appears to have been taken out to protect the starch meal, which is the product of the process described by the same author. (Eng. Pat. 4954). See above.—A. J. K.

Improvements in the Manufacture of Starch. W. R. Lake. From W. T. Jebb, U.S.A. Eng. Pat. 6139, May 19, 1885.

THIS patent is supplementary to the one described above (Eng. Pat. 4954), and has reference to the further treatment of the starch meal as it is obtained from the screen described therein. To obtain this meal in a finer state of division, and to free it from any remaining trace of fibrous matter or offal, it is treated as follows:—The meal is ground in a mill with water which passes from a pipe between the grinding surfaces of the mill. A separating sieve, covered with bolting cloth, receives the wet ground meal, and is provided with peforated pipes which, delivering fine sprays of water over the cloth, carry through the finely-ground starch, and work off the offal at the tail of the vibrating sieve. The water and starch are received into large settling tanks from which, when the starch has settled, the water is run off. The starch may now be dried and packed, or may first be further purified by repeated washing, either by pure water or very weak caustic soda solution. By this means a very pure fine starch meal may be obtained.—A. J. K.

Improvements in the Manufacture of Refined Sugar and Apparatus therefor. Peter Jensen. From M. C. P. Barbe, Amsterdam. Eng. Pat. 10,172, August 27, 1885.

BY the method described in this patent, the various processes necessary for the production of pure lump sugar from the "masse cuite" are conducted in rapid succession in one apparatus. This latter consists of a specially constructed centrifugal machine for the details of the construction of which reference must be made to the specification itself.—A. J. K.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(*A*) CHEMISTRY OF FOODS.

Depeptonisation and Theory of Digestion. T. Chandelon. Ber. **18**, 1999—2011.

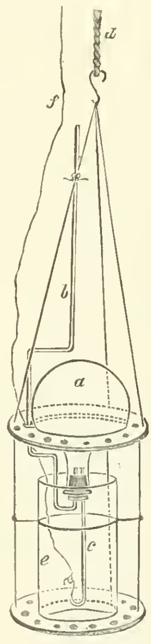
IN a former paper (*Ber.* 17, 2144) the author has observed the conversion of albumen into peptone by the action of hydrogen peroxide. The analogy of this reaction to

that induced in the process of digestion by peptic ferments lends support to either of the following hypotheses:—(1) The action of the ferment consists in the intermediate formation of hydrogen peroxide, or (2) that their constitution is similar to this compound. By a series of comparative experiments, the former hypothesis is shown to be incorrect; as regards the second, it is demonstrated that hydrogen peroxide can restore to activity pepsin rendered passive by sodium carbonate, whereas dissolved oxygen does not possess this property. It would thus appear that there exists in pepsin ferments a substance of the nature of a peroxide, which transforms albumen, or rather syntonin, into syntonipepsin with or without peptone; and, secondly, that dilute acids react on the syntonipepsin to produce a molecule of peptone, and a molecule of an intermediate substance, *zymogen*, which gives oxygen to reform pepsin. The substance *zymogen* is produced when peptonisation ceases, from the presence of too large an excess of fibrin; it is insoluble in glycerol, but by the action of acidified water is converted into peptone and pepsin. It is probably identical with the *insoluble pepsin* of Gaultier (*Compt. Rend.* 94, 582) and the pepsinogen of Elstein and Geutgner (*Ibid.* 652 and 1192).—V. H. V.

(*B*) SANITARY CHEMISTRY.

Dissolved Oxygen in Well-Waters. B. Lepsius. Ber. 18, 2487—2490.

In the choice of a water supply—especially in the case of well-waters—attention should be paid to the quantity of dissolved oxygen, and the rate at which this varies with the depth. The Berlin water supply, obtained from the Tegeler Lake, has proved to contain a dangerously large quantity of iron; and Finkener, in his investigation of this matter, has shown that the solution of iron proceeds with great ease whenever the quantity of dissolved oxygen in the water is diminished by gradual processes of oxydation; the percentage of CO_2 meanwhile increasing. According to Bunsen, water at 10°, which has been shaken up for some time with air, contains 12·7cc. nitrogen and 6·8cc. oxygen per litre, or 34·8 per cent. of oxygen, calculated with reference to the total of oxygen and nitrogen. In well-water, from wells sunk near the Tegeler Lake, Finkener found 10·91cc. nitrogen to 1·75cc. of oxygen, or only 13·8 per cent. of the latter, whereas the water of the Tegeler Lake itself contains 29·5 per cent. of oxygen; so that by gradual filtration into deeper strata, the percentage of oxygen is reduced from 29·5 to 13·8. That water readily loses its oxygen when placed in contact with organic matter, has been proved by Reichard, who has examined the action of turf upon rain-water. In five hours the water loses four-fifths of its oxygen, and after 48 hours only traces are left. Miller found that the dissolved oxygen and nitrogen in the Thames water above London (at Kingston) were in the proportion of 1 to 2, whereas below London (at Woolwich) the ratio was 1 to 52. Well-water is generally obtained from sandy strata, which contain more or less iron; and in deep wells the gradual absorption of oxygen can be recognised by examining samples of the water. Those from the upper strata are yellowish-red in colour; as the depth increases, and the iron changes from the ferric to the ferrous state, the colour becomes darker. If the water contains dissolved carbonic acid, then, in passing through the lower strata, the iron goes into solution, provided that there is not sufficient oxygen present to decompose the ferrous carbonate again into carbonic acid and ferric oxide. This is the reaction which occurs when ferruginous water is exposed to air, the water itself becoming yellow and dirty. It is evident that the extent to which the iron is dissolved will depend upon the quantity of organic matters undergoing oxidation, and upon the amount of dissolved oxygen: hence the importance of determining the latter constituent. In the presence of gypsum, another injurious effect may be produced: for if the water contain no oxygen, then the gypsum is reduced, by the oxidation of organic matter, to calcium sulphide, so that the water, on exposure to air, evolves sulphuretted hydrogen. In examining the Frankfort well-water, the writer had to take samples from bore-holes of only 8·15cm. diameter; the apparatus shown in the figure was found very convenient. It consists of an iron frame, the upper part of which supports an inverted flask *a* of 30cc. capacity, filled with mercury; through the indiarubber stopper pass the bent tubes *b* and *c*, which are also filled with mercury; *c* is drawn out to a capillary end, bent round, and a loose string *f* tied round it. The lower disc



carries the vessel *e*, and the whole apparatus is suspended by wires to the rope *d*. When it has sunk to the bottom of the bore-hole, the capillary point of *c* is broken off by pulling the thread *f*; the mercury flows into *e*, and is replaced by water flowing in through the tube *b*. The sample can thus be obtained without coming into contact with air, or with other water. It can be boiled in the same flask, and the gases determined as usual by Bunsen's method. The water was examined at depths of 12, 18, and 25 metres. At 12 metres, the percentage of oxygen was 24, at 18 metres, 22; but in passing from 18 to 25 metres the percentage fell to 13, and the water taken from the latter depth gave a slight yellow precipitate on standing in air.—D. E. J.

On the Influence of Industrial Processes on the Composition of River Water. Richard Caspari. Staatslehranstalt zu Chemnitz, 1884.

The first ten pages of this monograph consist of an interesting resumé of the general and historical aspects of the subject, special reference being made to the work and reports of the Rivers' Pollution Commissioners of 1865 and 1868. In spite of the mass of statistical matter collected by the said Commission, it could not be definitely stated that the fouled streams had a direct injurious influence on health, as it appears that the death-rate is subject to the action of so many other factors. In 1877, a map was prepared in Saxony, showing the

localities of 273 cases of gross river pollution, and accompanied by an explanatory text. It appears that establishments of the textile industry are by far the worst offenders in this respect, and in the first of these are specially named dye-works, bleach works, and woollen mills. In addition to the above, the following table shows percentages of cases in each trade calculated on the total number:—

Paper trade	9%
Leather trade	8
Mining	8
Preparation of foods, liquors, etc.	6
Illuminants, etc.	4
Manufacture of clothing, and cleansing the same	2
Chemical trades	2
Metal trades	1
Wood, etc.	0·3
Sewers of towns, etc.	7

The author then proceeds to discuss separately chemical means of purification, filtration, and irrigation. Of chemical methods are mentioned treatment with lime, Süvern's mixture (caustic lime, coal-tar, and magnesium chloride), and Sillar's A.B.C. mixture. Also several others of minor importance. With respect to the filtration method, it appears from the R.P. Commission report that good results are obtained if in 24 hours a maximum of 33 litres of water comes into contact with each cubic metre of filtering mass. Consequently this plan entails large and costly plant and settling tanks, but is to be recommended for smaller quantities. Recently a large number of filtering arrangements have been devised and patented; amongst others being H. Petri's method (D.R.P. 19,098, November 10, 1881) of covering the actual filter with a layer of turf treated with creosote. Irrigation methods give an intermittent filtration of the very best kind. Not only is suspended matter removed, but the substances in actual solution are chemically altered. Irrigation experiments at Norwood, Croydon, Aldershot, and various towns on the continent are briefly discussed. Irrigation, besides for liquid and solid fæcal matter, is specially suitable for treating the waters from dyeworks, tanneries, soap works, sugar mills, woollen mills, etc. This plan would be much more extensively used if the required ground were always at disposal. The following industries are then discussed more minutely in the combination given below:—

(*a*) Bleach, dye and print works.

(*b*) Woollen and cloth mills.

(*c*) Paper mills, mechanical pulp mills, straw board and cellulose works.

(*d*) The utilisation of ammoniacal liquors from gas works.

(*e*) Breweries, distilleries, sugar mills, and tanneries.

(*a*) From the works in this section very large volumes have usually to be dealt with. In addition to strong dyes and the chemicals employed in the baths, we have here to do with exhausted dye-woods, plant residues, cow-dung, fibres, etc. The chief point to be attended to is the removal of suspended matter as far as possible, seeing that the dissolved matter is usually much diffused in large volumes of water. If the lime treatment be employed, the tanks for settling should be as large as possible, and arrangements made for causing the water to travel as long a distance as practicable before being run out of the said tank or reservoir. The large dyeworks would do well if they were to treat the spent baths separately, as when diluted by the almost pure water from the rinsing baths a perfect or efficient treatment becomes almost impossible. The more concentrated the waters, the easier they are to precipitate and clear by means of lime. The lime process has been objected to as not attaining the desired end. This may be true with excrementitious matter, but for dyeworks, etc., it is by far the best and cheapest plan. Acids and colouring matters are combined, metallic oxides from mordants, albuminous and other matter liable to putrefactive change is precipitated in an insoluble form. The problem of rendering harmless the waters from dyeworks, etc., has been well solved by Messrs. W. Spinder, of Berlin. They mix their spent baths, the contents of urinals and closets, and waste waters generally, after settling out, with lime and magnesium chloride, and then employed irrigation. A full description with analyses at various stages is given. Some idea may be given of the quantities of soluble matters introduced into river waters by dyeworks, etc., when it is stated that analysis of the water from a certain cotton dyeworks showed a solid residue of 1·516grms.' per litre. Bleach-works usually turn out alkaline and soapy liquids containing small quantities of free acid and chlorine with calcium chloride and calcium sulphate. Large quantities of froth are also met with. As the organic matters are mostly fat acid salts of alkalis, sizing mixtures and suspended fibres, the dark leys are mixed with the soap-water, settled out, mixed with the waste bleach liquors, settled again, and then run off diluted with large quantities of rinsing waters.

(*b*) Wool and cloth mills should be subjected to severe control, especially as progress has been made in the profitable utilisation of the waste products resulting. The following are analyses of wool by Faisst:—

	(*a*)	(*b*)
Mineral matter	6·3	16·8
Fatty matter ("suint" etc.)	41·3	44·7
Pure wool fibre	38·0	28·5
Moisture	11·4	7·0

Chevreul has shown that "suint" contains the potash salt of a fatty acid. Reich and Ulbricht found oleates, stearites, probably palmitates; and according to E. Schulze benzoic acid and cholesterin are never missing. In some mills the waste wash-waters are concentrated to a syrup and then distilled for gas with ammonia, tar and potash as by-products. E. Schwammborn, in Aachen, has introduced a lime process into actual practice, which gives good results. The lime soap obtained is mixed with coal and worked for gas. The cloths mills at Daleran, near Lennep, use a modification of Schwammborn's process, and work their lime soap for fat. It is stated that the wash-waters produced yearly in Europe correspond to 2,000,000cwt. lime soap. Various other patented processes are then described.

(*c*) Paper-mills and allied establishments have a great influence from a sanitary point of view. We have here to deal with the leys from boilers, the washings from the various classes of rag-engines, back-water, residues from bleaching powder, etc. In addition to soda, lime, china-clay, and many other mineral matters, we meet with large quantities of putrescible organic matter causing discolouration, froth, and the death of fish. The ley from the rag-boilers is muddy, alkaline, and soon gives off SH_2. That from straw is clear, dark-brown, and slightly alkaline. Analyses are given. If the two are united in a water-course, a very large amount of contamination results. Esparto liquors are still worse, and have been found to contain as much as 938·845 parts of organic carbon, and 77·042 parts of organic nitrogen per 100,000. In some cases, owing to the large amount of soda in these liquors, regeneration does away with them in a profitable manner (as much as 80 per cent. of the Na_2O used can often be recovered.—Abstractor).

The recovery of fibres from the waste waters does not cause much trouble when "save-alls" are used. The waste-waters from mechanical pulp mills, from soda-pulp mills, and from sulphite cellulose manufactories, are also considered separately. The waste-water from wood-steaming works is rather of an antiseptic nature.

(*d*) Gas-waters are those derived from the condensing and scrubbing arrangements, and are always mixed. These are now mostly worked up for valuable products. In examining a water-course for contamination from gas-works, the chief to look for is the presence of the salts of the lower sulphur acids, which are characteristic. Empyrematic matter and sulphide of ammonia are often retained by the earth; the smell of the tar would then of course be absent. Nitrous acid is also of importance.

(*e*) The waste-waters from breweries vary in composition according to the cereals employed. More or less gummy matter, sugar, soluble legumin and plant fibrin are always present; also potash, lime, magnesia, silicic acid, sulphuric and phosphoric acids.

In the wash-waters from barley, succinic acid has also been found. Special attention must be paid to these

waters in summer time, when they greatly favour the formation and development of one of the algæ—viz., *Leptomitus lacteus*.

The lime process is found to answer very well in this and similar cases. Also in certain cases Süvern's mixture. The precipitate being rich in nitrogen and phosphoric acid, can be used as manure.

The waters from distilleries can be similarly treated with advantage. Here we have liquors at a high temperature containing much putrescible organic matter, also fusel oil, amyl alcohol, acetic and valerianic acids.

Great dangers are attached to contamination from "vinasse" liquors containing undecomposed starch, dextrine, peptone, proteids, fat, small quantities of maltose and dextrose, salts, yeast, glycerine, etc.

Camille Vincent's process has been a signal success, allowing, as it does, of the disposal to considerable advantage of these dangerous liquors.

Sugar works are also serious offenders, likewise tanneries. Causes and cure are discussed.—H. A. R.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Galvanic Batteries. A. Schanschieff, Gipsy Hill, Surrey. Eng. Pat. 16,375, Dec. 12, 1884.

The positive and negative elements of a battery are made in the form of discs, and are mounted upon an axis made of insulating material; the axis of the discs is placed upon bearings above the top of a trough, partitioned off into cells, into which the lower part of the discs dip, so that one half of each disc will be exposed to the atmosphere, and the other half will dip into the liquid in the trough. When the battery is in action, a slow revolving motion is given to the axis, either by means of a small dynamo-electric engine, which receives a portion of the battery current, or by a small water-wheel, or by other convenient means.—T.

An Improved Apparatus and Process for the Electrolytical Separation and Deposition of Metals. A. M. Clark. From Bernhard Moebius, Chitmahua, Mexico. Eng. Pat. 16,554, December 16, 1884.

This patent consists of sixteen claims, and relates to a process and apparatus for refining silver and separating it from gold, platinum, copper, lead, and other metals by means of electricity, which apparatus when slightly modified can be used in other electrolytical processes for the decomposition and precipitation of metals by electricity.—T.

Improvements in Secondary Batteries. W. H. Akester and R. Mitchell, Walham Green, and R. R. Kelly, Queen Victoria Street. Eng. Pat. 1221, Jan. 28, 1885.

The object of this invention is to so construct the cells of a lead secondary battery, as that the acting agents required for any given capacity of storage will be concentrated in a considerably less space, and will be disposed in a far more advantageous and effective manner than in any accumulator or seecondary battery as formerly constructed, and which will consequently permit of any given amount of electric energy being stored in a battery occupying considerably less space, and weighing very much less than any existing secondary battery capable of storing and effectually utilising a like amount of electric energy.—T.

Improvements in and relating to Electric Batteries. W. R. Lake. From H. L. Brevoort and J. L. Roberts, both of Brooklyn, New York. Eng. Pat. 1505, February 3, 1885.

In order to prevent polarisation in electric batteries having zinc and carbon elements, the author proposes to use solutions of permanganate of potash and bichromate of potash, instead of a solution of sal-ammoniac, which is generally used. Under this patent is included a novel connection of a metal conductor to a carbon element by means of a conductive metal or metallic alloy applied in a molten state, and being of such a character that it will expand on cooling, so as to secure the carbon element and conductor together.—T.

XIX.—PAPER, PASTEBOARD, Etc.

On the Moisture contained in Materials for Paper Manufacture. B. Lepsius. Ber. **18**, 2491—2492.

The price of these materials (prepared from wood) is generally based upon the weight of the "air-dried" substance; but as this term is somewhat indefinite, an average sample is usually taken, dried by heating for a considerable time to 100°, and twelve per cent. moisture added to the weight of the dry substance thus determined. The following observations were made in order to test the correctness of this method, and the results show that the percentage which should be added varies according as the materials have been prepared by chemical means or by mechanical processes alone. The materials were examined in the state in which they came from the machine; the samples were allowed to remain in a room at a constant temperature of 20° until the weight became constant, the amount of moisture present being determined by a hygrometer, and maintained constant at fifty-five per cent. relative humidity. All determinations of "air-dried weights" were made under these normal conditions, for preliminary experiments showed that changes in temperature or humidity produced considerable variations in weight. The samples were then dried at 100°, and quickly weighed; a comparison of both weighings gave the amount which should be added to the latter. In the case of materials prepared by mechanical means from aspen wood (white) and deal (white and brown) the usual methods were found correct; but the so-called celluloses, prepared from wood and straw, by the soda and bisulphite processes (both bleached and unbleached), required the addition of only ten per cent. to the weight of the substance dried at 100°.—D. E. J.

Improvements in Manufacture of Materials for Making Artificial Ivory, etc. T. F. Best, Middlesex. Eng. Pat. 15,121, November 18, 1884.

It is proposed to manufacture an improved substitute for ivory, horn, coral, amber, malachite, whalebone, guttapercha, etc. Cellulose matter is first treated in the usual manner with a mixture of H_2SO_4 and HNO_3, and the excess of acid neutralised by heating the mass with a solution of SO_2, preferably in a closed vessel and to about 100° F. Pressure is employed to remove the acid solution, and then 10—50 gallons of water are added to every 50lb. weight of mass. Washing then follows, to remove all traces of soluble acids, and then bleaching, if required. Crude camphor is dissolved in about its own weight of methylated spirit, or methylated spirit and liquid hydrocarbon mixed, passed through a percolator charged with any suitable drying agent, and decolourised by the use of charcoal. To every 50lb. of cellulose treated as above, inventor adds 55 to 60lb. of the above solvent to form a plastic mass. The mass can be coloured, if required, and for decreasing the inflammability of the mass 12·5 to 25 per cent. of borate of magnesium is added.—H. A. R.

Improvements in the Treatment of Paper and other Fibrous Materials for the Production of a New Material and of Articles therefrom. H. W. Morrow, Wilmington, U.S.A. Eng. Pat. 9319, Aug. 4, 1885.

Paper is converted into a pasty substance by the action of HNO_3, or the nitrates of zinc or lime. Other acids, bases, salts or solvents of cellulose may be added to the bath, as may also cupra-ammonium, zinc-ammonium, or chloride of zinc. If nitric acid be used alone, inventor prefers a strength of 42—49° Bé. If nitrates be used, 55—75° Bé. is prescribed. Sized or unsized sheet paper may be treated to produce (*a*) tough and strong texture, high polish, non-inflammability, and

resistance to acids and alkalis; (*b*) softness and flexibility. Sheets may be cemented together to form slabs or rolls, if required. The sheet or slab is then soaked in alkaline or clear water, according to the character of the product required, and may receive a coat of gum, oil, albumen, glycerine, saccharine matter, or any mixture of the same. Compound sheets may be made by the interposition of woven materials between the sheets. Starch, gum, mucilage, dextrine, albumen, or any form of cellulose may be advantageously introduced in addition, either with the paper or with the fabrics; also, if desired, earthy and mineral matters. Softening, etc., may be done by the use of glycerine baths, etc.—*e.g.*, two-thirds water, and the remainder glycerine or glycerine and saccharine matter combined. Patentee, however, prefers to accomplish this by means of deliquescent salts introduced into the substance of the material, to which he gives the name of "celluvert." The following are some of the uses to which inventor proposes to put the new material: Roving cans, pump valves, plate glazing strips, tubes, gibs for engine cross-heads, friction gears, gaskets, sounding boards, washers, acoustic aids, non-conductors of electricity, etc., etc.

—H. A. R.

Improvements in Waterproofing Paper and other Materials. W. Macrone, Glasgow. Eng. Pat. 9411, August 7, 1885.

INVENTOR carries the paper to be waterproofed in a web through a tank of size, heated to 212° F. at a sufficiently slow rate. After passing suitable arrangements for removing the surplus, the paper receives a coating of powdered steatite, the excess being brushed off. The size or varnish to be employed forms the subject of another patent deposited at the same time.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Commercial Cocaïne. W. Merck. Ber. **18**, 2264—2266.

THE author recently pointed out the existence of an alkaloid, benzoyl-ecgonine, in commercial cocaïne. He has now succeeded, by introducing a methyl group into this compound, in converting it into cocaïne. An attempt was first made by heating the compound with methyl iodide and caustic potash in sealed tubes at 100°, but the benzoyl-ecgonine was decomposed with formation of methyl benzoate and methyl alcohol. By employing a slight excess of methyl iodide, an equal volume of methyl alcohol, but no caustic potash, the hydriodide of cocaïne was formed. The methyl iodide and methyl alcohol were removed by distillation, and the syrupy residue treated with water, when the hydriodide slowly crystallised. The aqueous solution was treated with moist silver oxide, and filtered. The residue was washed with cold water to remove unaltered benzoyl-ecgonine, and the cocaïne dissolved in hot alcohol. After recrystallisation from alcohol it melted at 98°, and the alkaloid, and its platinum double salt, were analysed.—S. Y.

On Some Derivatives of Methylhydroquinoline. Adolf Feer and Wilhelm Koenigs. Ber. **18**, 2388—2393.

QUINOLINE methyliodide was dissolved in ten times the quantity of concentrated hydrochloric acid, and treated on the water bath with $1\frac{1}{2}$ parts of granulated tin. A red tin double salt separated, became white, and was finally redissolved. The solution was concentrated, made alkaline with strong caustic soda, and steam-distilled. The distillate was shaken with ether, and the ethereal solution dried with potash. After removal of the ether by distillation, the residue was fractionated. The greater part of the kairoline distilled over between 242° and 244°, and nearly half the calculated amount was obtained. Methylhydroquinoline or kairoline resembles dimethylaniline in its behaviour with nitrous and nitric acids, and with benzenyl trichloride, whence the authors conclude that in the nitroso and nitro compounds, a hydrogen atom of the benzene ring, in the para-position with regard to the nitrogen, is replaced.

Nitrosokairoline, $C_{10}H_{12}N.NO$. A solution of kairoline in 50 parts of very dilute sulphuric acid was treated gradually at 0° C. with the calculated quantity of sodium nitrite. The yellowish red solution was neutralised with soda, and agitated with ether. The residue, after evaporation, was recrystallised from petroleum spirit, animal charcoal having been added to the solution. After further purification, the compound crystallised in green scales, resembling nitroso-dimethylaniline. It dissolves readily in alcohol, ether and benzene; less easily in petroleum spirit. It has no definite melting point. The composition was confirmed by analysis. Nitrosokairoline does not give Liebermann's reaction, nor is it decomposed in the same manner as nitroso-dimethylaniline, by boiling with caustic soda.

Nitrokairoline, $C_{10}H_{12}N.NO_2$. Kairoline was dissolved in 10 parts of concentrated sulphuric acid, and treated drop by drop at 0° C. with the calculated quantity of potassium nitrate dissolved in strong sulphuric acid. The product was poured into water, and neutralised with caustic soda, when nitrokairoline was deposited in red crystals. After purification of the alcoholic solution with animal charcoal, the compound crystallised in red needles, melting at 93—94°. It dissolves in the ordinary solvents, and possesses basic properties like kairoline. It is unaltered by solution in strong acids and subsequent precipitation by water. The body was analysed.

Dinitrokairoline, $C_{10}H_{11}N(NO_2)_2$. A solution of kairoline in glacial acetic acid was treated at the ordinary temperature with the calculated quantity of fuming nitric acid, diluted with five parts of acetic acid. A portion of the dinitrokairoline was deposited, the remainder was obtained by addition of water, neutralisation with caustic soda, and agitation with ether. The dinitro compound crystallises from alcohol in yellow scales, melting at 148°. The composition was proved by analysis. It is not decomposed by strong acids.

Amidokairoline, $C_{10}H_{12}N.NH_2$, was prepared by reduction of the nitro-compound, dissolved in concentrated hydrochloric acid, by means of stannous chloride. The solution was neutralised with caustic soda, and extracted with ether. A yellow oil was obtained, which crystallised at a low temperature. The platinum double salt was found to have the composition $(C_{10}H_{14}N_2.2HCl)PtCl_4$.

By the action of sodium nitrite on a solution of amidokairoline in 10 per cent. sulphuric acid, cooled by a freezing mixture, red needles of the sulphate of a base were obtained, which, when heated, evolved no nitrogen, but crystallised out again on cooling. By the addition of caustic soda to a strong aqueous solution of the sulphate, violet crystals, having the composition $C_{10}H_{13}N_3O+5H_2O$, were obtained. This body melts and decomposes at 144°. It does not give Liebermann's reaction. The hydrochloride, dried at 140°, has the composition $C_{10}H_{13}N_3O.HCl$. The oxygen in the free base does not, therefore, exist as hydroxyl.

Dimethylhydroquinolinium hydroxide. Tetrahydroquinoline was warmed with excess of methyl iodide on the water bath. After evaporation of the methyl iodide, the solution was shaken repeatedly with ether, and hydrolysed to remove unaltered tetrahydroquinoline and kairoline. The hydroxide was obtained by conversion of the iodide into the ferrocyanide, decomposition with copper sulphate, and precipitation of sulphuric acid with barium hydrate. The concentrated aqueous solution was heated to 150°, in an oil-bath. Water distilled over at first, later on, oil, which was driven over completely by passing steam into the residue. The oil was found to be kairoline. The decomposition of dimethylhydroquinolium hydroxide differs, therefore, entirely from that of the corresponding pyridine compounds, which form trimethylamine and unsaturated hydrocarbons.—S. Y.

Vogel's Test for Quinine. A. Vogel. Sitzungsber. d. Akad. d. Wissensch. München, 1885, I.

THE author has modified his original test for quinine, which consists in mixing bromine water, yellow prussiate of potash, and borax, to a solution of quinine, by substituting a weak alkaline compound, as for example, marble, felspar, or powdered glass, for borax. When to

a mixture of bromine water, ferrocyanide of potassium, and sulphate of quinine, a small piece of marble is added, the latter is at once covered with a red film. Strychnine, cinchonine, and caffeine do not give similar reactions. If a solution of morphine be boiled with excess of bromine water, neutralised with $CaCO_3$, and again boiled, a red coloration is produced, even when diluted to 1 in 1200. When more dilute, a yellow or brown coloration is obtained. If a weak HCl solution of narcotine be treated with a small excess of bromine water, and neutralised with calcium carbonate, the liquid becomes red. When the solution contains more than 1 in 1000, the red colour changes to violet and blue. The coloration is weaker in presence of tartaric or acetic acids. In testing quinine in bark, the tannin present must be first eliminated with gelatine solution, containing NH_4Cl.
—J. B. C.

XXI.—EXPLOSIVES, MATCHES, Etc.

An Improved Combustible Composition to be employed in the Manufacture of Cigar Lights or Fusees. G. A. Sweetser, Kennington. Eng. Pat. 13,109, October 2, 1884.

The object of this invention is to provide a light which shall burn down without spluttering, and shall also continue to glow for some time after it has burned down. The heads are composed of a mixture of two parts of powdered charcoal with one of chlorate of potash, and a sufficiency of gum water, or other adhesive liquid. The heads are tipped by an ordinary dipping process, with any suitable igniting composition.—W. D. B.

Improvements in the Manufacture of Gunpowder. R. W. S. Griffith, Lyndhurst. Eng. Pat. 11,808, August 30, 1884.

This invention relates to improvements in the manufacture of the so-called Schultze wood or sawdust gunpowder, and what is claimed is: firstly, the granulation of a moistened mechanical mixture of nitro-lignin and nitrates, by passing the same through sieves and through revolving barrels or drums; secondly, the treatment of the powder with paraffin, indiarubber, resin, starch, silica, or other inert substances, to diminish the rapidity of combustion and liability to detonation; thirdly, the improved Schultze gunpowder made substantially in the manner set forth.—W. D. B.

Improvements in Explosive Compounds. G. G. André, Dorking. Eng. Pat. 13,476, October 11, 1884.

This invention relates to the preparation of a compound for use in blasting, of which the combustible and the oxidising agents are kept separate until the explosive is required for use. The combustible consists of a mixture of linseed-oil, paraffin wax, and carbon bisulphide, to which may be added, for the sake of economy, a hydrocarbon liquid. This mixture possesses, at ordinary temperatures, a consistency like that of butter, and does not easily lose its bisulphide of carbon. The oxidising agent consists of powdered saltpetre and potassium chlorate, or the latter alone, contained in a porous envelope of cartridge form. The explosive is prepared for use by immersing for two or three minutes the cartridge containing the oxidising agent in the above described combustible mixture liquefied by heat.—W. D. B.

Improvements in the Manufacture of Explosive Compounds. B. Brones, Vienna. Eng. Pat. 14,140, October 25, 1884.

Double salts of picrate of sodium with picrate of lead or picrate of barium are prepared by adding one equivalent of picrate of barium or lead to a solution of three equivalents of picrate of sodium, the crystallisation of the double salt being assisted by cooling the solution. These double salts are employed for blasting purposes, preferably in combination with picrate of potassium and nitronaphthalene, and in addition to these, potassium nitrate, sugar, gum, pure soot and lampblack, may be employed in conjunction. The proportions of the mixture are chosen according to the purpose to which the compound is to be applied, and can be varied within about the following limits:—

Picrate of barium and sodium	30—15%
Picrate of lead and sodium	30— 8
Picrate of potassium	10— 2
Nitro-naphthalene	5—20
Nitrate of potassium	20—40
Sugar	1½— 3
Gum	2— 3
Soot or lampblack	½— 4

The nitro-naphthalene employed by preference is a highly nitrated product, consisting of a mixture of the di-, tri-, and tetra-nitro compounds. The inventor claims the employment and application of the double salt compounds of picrate of sodium, with other picrates, and the application, in explosive compounds which contain the above-mentioned double salts, of highly nitrated naphthalene, "for the purpose of obtaining on the one hand the utmost possible oxidation of the carbon; and on the other hand, a slower consumption of the explosive compound through the large quantity of nitrogen contained in the same, and for generally increasing the volume of gas evolved.
—W. D. B.

Improvements in the Manufacture of Explosive Compounds. F. Maxwell, Putney, and C. L. J. A. Lewall, Hanover Square. Eng. Pat. 14,379, Oct. 30, 1884.

This invention relates to the manufacture of explosive compounds by treating starch with potassium chlorate, and is carried into effect in several ways. First, the starch, previously worked into a thin paste with cold water, is treated with a boiling solution of potassium chlorate, and the gelatinous mass dried, and, if necessary, moulded or granulated. Second, the chlorated starch prepared according to the first method is incorporated with paraffin, vaseline, a hydrocarbon, fatty acid, rosin or gum. Third, the product of either the first or the second process is mixed with charcoal, sulphur, or a metallic sulphide, in order to increase the degree of sensitiveness and rapidity of action. Fourth, bran previously freed from amylaceous matters and gluten by a process of diastisation is employed in conjunction with the chlorated starch. Fifth, bark, tan, cellulose, or any vegetable fibrine is employed in conjunction with the chlorated starch, the latter mixture being added to one of the first-named materials whilst in the semi-gelatinous condition. Sixth, the sensitiveness of the explosive compound prepared according to any of the hereinbefore-mentioned methods is reduced or graduated by a substitution of part of the potassium chlorate by potassium nitrate. As an important advantage attendant upon the conjunction of starch with potassium chlorate, it is claimed that the latter salt shows very little tendency to segregate in crystals when the gelatinous mixture is dried. Hence on drying the mixture of bran with chlorated starch, the crystallisation of the chlorate at the surface of the bran does not occur to anything like the extent which it does in the case of ordinary chlorated bran.—W. D. B.

Improvements in the Formation or Preparation of Explosive Charges. E. J. Mills, Glasgow. Eng. Pat. 14,737, November 8, 1884.

The object of this invention is to obtain a means whereby the rate of combustion of powder contained in a cartridge for propulsive purposes, and in a bore-hole for blasting purposes, may be efficiently graduated. This end is attained by building up the charge of two or more layers of the explosive, the materials of the several layers being such as to burn with different degrees of rapidity.—W. D. B.

Improvements in Ammunition for Military and Sporting Small Arms and Field and Machine and other Guns. Lieut.-Col. W. Hope, Westminster. Eng. Pat. 14,915, November 12, 1884.

The object of this invention is to reduce the strain upon the gun set up at the moment of explosion of

the charge, by slightly moving the projectile, or bringing it into equilibrium by a sort of priming charge, and then immediately afterwards igniting the main charge. In the case of large guns, the inventor attained this end by using a cartridge containing a little gun in the centre (Eng. Pat. 2923, July 15, 1880). To adapt this principle to small arms and small guns, the cartridges have an axially arranged cigarette-like core or tube, which may be made of thin paper, charged with powder consolidated by pressure and perforated longitudinally; the primer, detonator, or cap communicates with the said longitudinal perforation. Or the cartridge may be charged with a block or blocks of powder, consolidated by pressure, and perforated axially from end to end, the primer or detonator communicating with the said axial perforation.—W. D. B.

Improvements in Propelling Composition and Cartridges for Ordnance. G. Quick, Gloucester. Eng. Pat. 15,546, November 26, 1884.

THIS invention relates to the manufacture of discs or cakes of meal-powder, gunpowder or other gas-producing composition, and consists in the production of such cakes or discs with a large perforation in the centre, and a number of smaller perforations connected with each other by radial and concentric channels or grooves formed in the surface of the cake by moulding or cutting. The object aimed at is the obtaining rapidity of ignition with uniformity of combustion. In preparing cartridges for ordnance with such discs, care is taken that the large central orifices in the discs shall be in the centre or axis of the cartridge, and in line with the axial vent of the gun.—W. D. B.

Improvements in the Manufacture of Gunpowder. J. N. Heidemann, Cologne. Eng. Pat. 16,314, December 11, 1884.

STRAW is carbonised until it attains a brown chocolate coloured appearance, and the carbonaceous substance obtained is cooled, pulverised, and mixed with potassium nitrate and sulphur, in the proportion of eighteen per cent. of the brown carbonaceous substance, seventy-nine per cent. of potassium nitrate, and three per cent. of sulphur.—W. D. B.

Improvements in the Construction of Rockets. J. Whitley, Leeds. Eng. Pat. 3429, March 17, 1885.

THE object of this invention is to provide a means whereby oil may be thrown upon the surface of the sea from a distance. In accordance with this, the rocket is provided with a glass or other vessel of oil embedded in a fulminating composition, which is fired by a fuse when the rocket composition proper is spent. Details are given of various mechanical arrangements which the inventor adopts.—W. D. B.

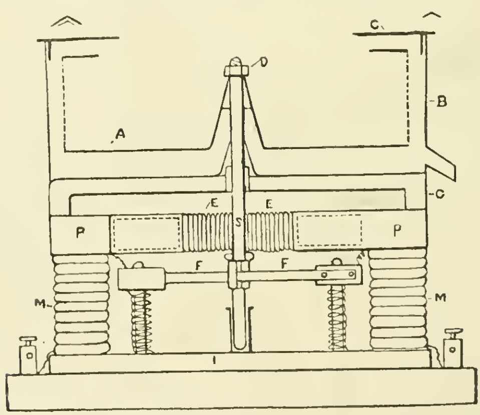
Improvements in Caps or Apparatus for Exploding Dynamite and other Explosives. J. Paulus, Berlin. Eng. Pat. 4853, April 20, 1885.

THE object of these improvements is to direct the force of explosion in the direction of the longitudinal axis of the explosive mass in which the detonator is embedded. The general principle is to weaken or otherwise manipulate the bottom of the copper shell, so that the resistance opposed to the force of explosion of the detonating composition is less here than at other points of the shell. The inventor describes a variety of plans in detail, whereby he is enabled to apply this general principle.
—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

An Electrical Centrifugal Machine for Laboratories. Alexander Watt. Paper read before Section B, British Association, Aberdeen Meeting.

THE late Dr. Mohr ("Lehrb. d. Chem. Analyt. Titrirmethode," 3rd Ed., 1870, p. 684) of Bonn, advocated the use of a centrifugal machine as a means of rapidly drying crystals and crystalline precipitates, but although they are admirably adapted for that purpose, centrifugal machines are seldom seen in our chemical laboratories.



The neglect of this valuable addition to our laboratory apparatus is probably owing to the inconvenience involved in driving the machine at a high speed by means of the ordinary hand-driving gear, especially when the rotation has to be maintained for a considerable length of time. It occurred to me, therefore, that by attaching the drum or basket of the machine (or the rotating table of Mohr's apparatus) directly to the spindle of an electro-motor the difficulty of driving might be got over, and at the same time a combination of great efficiency would result, as the electro-motor, like the centrifugal machine, is most efficient when run at a high speed. The apparatus shown in the sketch consists essentially of a perforated basket A, which is slipped on to a cone attached to the spindle S of an electro-motor, and held in position by the nut D. The casing B, with its removable cover C, serves to receive the liquid driven out of the substance being dried. A flat form of the ordinary Siemens H armature

E, revolves between the poles P, of the electro-magnets M, which are connected by means of the base plate I. The brass cross-bar G carries the top bearing of the spindle S, and prevents the magnet poles from being drawn together.

From four to six cells of a bichromate battery or Faure secondary battery furnish sufficient power to run the machine at a high speed. An apparatus, with a copper basket four inches in diameter, has been found extremely useful in the laboratory for drying such substances as granulated sulphate of copper and sulphate of iron and ammonia, but more especially for drying sugar, which, when crystallised in very small crystals, cannot be readily separated from the syrupy mother-liquor by any of the usual laboratory appliances. For drying substances which act on copper, the basket may be made of platinum or ebonite; in the latter case, owing to the increased size of the perforations, it may be necessary to line the basket with platinum wire gauze or perforated parchment paper.

Detection and Estimation of Fluorine. G. Tammann. Zeit. Anal. Chem. 1885, 328.

WÖHLER'S method of determining fluorine, by heating with sulphuric acid, in presence of silica, and estimating the loss (SiF_4), is less trustworthy than when the latter is directly estimated by absorption, by $CaCl_2$. A series of determinations by the latter method (Fresenius, *Ibid.* 5, 190), gave numbers approximating to the theoretical. If sulphurous acid be simultaneously evolved it should be removed by interposing an absorption tube containing chromic acid dissolved in concentrated sulphuric acid. For determining hydrofluoric acid the author recommends precipitation by barium salts ($BaBr_2$) as silicofluoride in presence of a soluble silicate, and alcohol (50 per cent.). Accurate results are obtained even with very dilute acids. In cases where barium sulphate is simultaneously precipitated, the precipitate is ignited, the resulting barium fluoride dissolved out by hydrochloric acid, and the residual sulphate estimated. Or the fresh precipitate is digested on the water-bath with a solution of ammonium phosphate, and the resulting barium phosphate dissolved out, after filtering and washing, by means of hydrochloric acid.

In the decomposition of silicon tetrafluoride by water, a process incidental to several methods of analysis, the author calls attention to the formation of an insoluble fluo-silicic compound. After discussing the errors due to this and other defects in some of the usual methods, the author cites the following analysis as conveying the general principles to be observed :—

Potassium silicofluoride was decomposed by sulphuric acid, and the silicon tetrafluoride absorbed in the usual way. The contents of the absorption vessel were rendered alkaline with potash, evaporated to dryness, the residue treated with hydrochloric acid, the excess of the latter subsequently removed by adding potassium acetate. 3 vols. alcohol (80 per cent.) were then added, and after allowing to stand 2—3 hours, the potassium silicofluoride was filtered off, well washed and titrated with potash according to Stolba's method (*Ibid.* 2, 396). The following experimental numbers show the degree of accuracy attainable by this method :—

K_2SiF_6 taken.	K_2SiF_6 estimated.	Difference.
0,5582	0,5522	—0,0060
0,2146	0,2128	—0,0018
0,0068	0,0057	—0,0011

The following gravimetric method is recommended in the case of soluble fluorides. Hydrobromic and silicic acids are added to the solution, then barium acetate, and lastly alcohol. The precipitate is washed with alcohol, and then with hydrofluoric acid (on a platinum funnel) to remove silicic acid. The barium silicofluoride may then be weighed as such, or converted into sulphate.

In isolating fluorine from mixture or combination with organic substances, the author finds that it is impossible to avoid considerable loss in the preliminary incineration, even though the substance be previously mixed with barium hydrate or sodium carbonate in relatively large quantity.

For detecting traces of fluorides the author finds the method of Hoffegesler (*Handb. Phys. Path. Anal.* 1875, p. 454) to be one of sufficient delicacy.—C. F. C.

A New System of Volumetric Analysis. C. Winkler. Ber. 18, 2527—2533.

IN the introduction to his Text-book of Volumetric Analysis, Mohr points out that it is necessary to make up standard solutions of a certain definite strength, in order to simplify calculations. He suggests that the liter should contain "either one atom, or one-tenth of an atom, in grammes, of the active substance;" and afterwards defines the former as being normal, the latter as deci-normal. Mohr's book was published more than thirty years ago, at a time when dualistic ideas and formulæ were still in use, and when atomic and equivalent weights were regarded as identical. Now, however, the old combining weights are no longer in use; the adoption of unitary formulæ, the discovery of the law of volumes, and the progress of the theory of valency, have considerably altered our conceptions as to atoms and molecules; so that the old system of volumetric analysis, based upon the theory of equivalents, is not in accordance with our modern atomic and molecular weights.

Taking the weight of an atom of hydrogen as the unit of weight, the corresponding quantities of other substances were naturally represented, on the old theory of equivalents, as follows :—

1 atom of hydrogen = 1 atom of oxygen = 8O
1 „ „ = 1 „ sodium = 23Na
1 „ „ = 1 „ sodium carbonate = 53NaOCO$_2$
1 „ „ = 1 „ hydrochloric acid = 36·5HCl
1 „ „ = 1 „ sulphuric acid = 49HOSO$_3$.

The introduction of the idea of molecules, and of atoms of different valency, has apparently destroyed the simplicity of the above relations, for we now regard the following as being corresponding quantities :—

1 atom of hydrogen = ½ an atom of oxygen = $\frac{16}{2}$ = 8O
1 „ „ = 1 „ sodium = 23 Na
1 „ „ = ½ molecule of sodium carbonate = $\frac{106}{2}$ = 53Na_2CO_3
1 „ „ = 1 „ hydrochloric acid = 36·5 HCl
1 „ „ = ½ „ sulphuric acid = $\frac{98}{2}$ = 49H_2SO_4

Winkler finds that the necessity for working sometimes with half, and at other times with the whole molecular weight, is a source of great confusion, especially to beginners. The rule frequently given for finding the equivalents (equivalent weight = atomic weight divided by valency) does not remove the difficulty, for according to it we have the relations—

1 atom of hydrogen = ⅓ atom of nitrogen = $\frac{14}{3}$ = 4·66 N$^{\text{III}}$
1 „ „ = ⅓ „ arsenic = $\frac{75}{3}$ = 25 As$^{\text{III}}$;

whereas in titrating nitrogen in the form of ammonia with normal acid, or converting As_2O_3 into As_2O_5 by iodine-solution, the equivalent quantities are :—

1 atom of hydrogen = 1 atom of nitrogen = 14 N
1 „ „ = ½ „ arsenic = $\frac{75}{2}$ = 37·5 As.

As it is of the greatest importance that the learner should have a clear conception of the theoretical consideration upon which the system of analysis is based, the writer has* suggested the adoption of a new unit of weight—namely, the weight of a molecule of hydrogen. Taking this as a standard, the following relations are at once evident :—

$$H_2 = Na_2 = Ca = O = I_2.$$

The equations upon which the titrations depend are now written in an uniform manner, so that in all cases a molecule of hydrogen (H_2) enters into the reaction; as a

* "Die Maassanalyse nach neuem titrimetrischen System." Feiberg, 1883.

rule this is naturally the case, for in all methods of oxidation and reduction an atom of divalent oxygen comes into play :—

$$H_2SO_3 + H_2O + I_2 = H_2SO_4 + 2HI$$
$$SnCl_4 + 2HCl + O = SnCl_4 + H_2O$$
$$Na_2CO_3 + 2HCl = 2NaCl + CO_2 + H_2O$$
$$2NaOH + 2HCl = 2NaCl + 2H_2O.$$

A glance at the equation shows the quantity of a substance which enters into reaction, and also indicates the amount or "normal weight" which must be taken for the standard solution. An experience of 15 years has shown the system to be very convenient and easily understood. One advantage lies in the fact that all normal solutions thus prepared are of equal value. The same oxalic-acid solution will serve for determining the amount of potash in potash-lye, of ammonia in ammonium sulphate, of carbon dioxide in a cement, or for testing the strength of a permanganate solution.—D. E. J.

Detection of Chlorides in presence of Bromides and Iodides. L. L. de Koninck. Zeit. Anal. Chem. 1885, 376—379.

The method of conversion into chromyl chloride is untrustworthy, as the chlorides are, under certain circumstances, otherwise decomposed—viz., according to the subjoined equation :—

$$6MCl + K_2Cr_2O_7 + 7H_2SO_4 = K_2SO_4 + Cr_2(SO_4)_3 + 3M_2SO_4 + 7H_2O + 3Cl_2.$$

The following method is therefore recommended : The mixed haloid silver precipitate is digested with 4—5vols. of a 10 per cent. solution of ammonium sesquicarbonate, for some minutes in the cold. On filtering and adding a drop of a solution of potassium bromide, the presence of a chloride is revealed by a precipitate of silver bromide.—C. F. C.

Laboratory Apparatus for Operations requiring Exclusion of Air. N. V. Klobukow. Zeit. Anal. Chem. 1885, 395—399.

The essential portion of this apparatus (Figs. 1 and 2) consists of the two funnels T_1T_2, which are bound together at their edges by means of an indiarubber band. In other respects the details of construction require no further explanation. The apparatus may be used for evaporation from the beaker B in an atmosphere of any desired gas, as well as in vacuo or under diminished pressure ; for drying a substance contained in the funnel space, in which case B may be used for heating the stream of indifferent gas. So also for washing out a precipitate; and indeed by means of suitable slight variations in the arrangement, for any operation requiring the condition in question.—C. F. C.

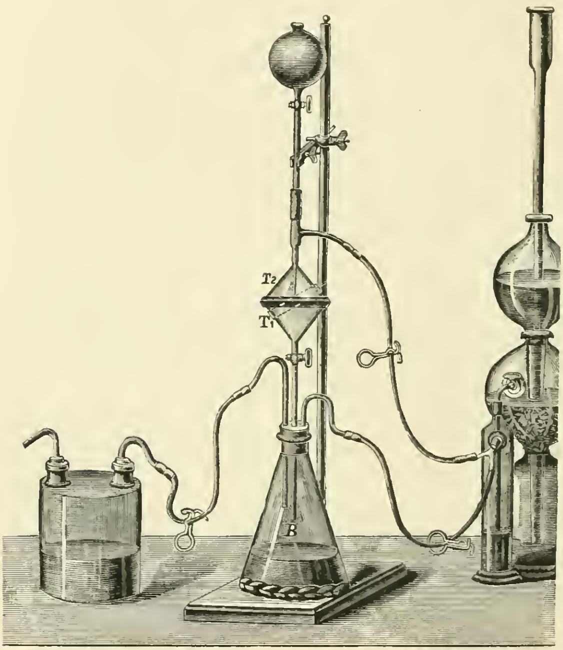


Fig. 1.

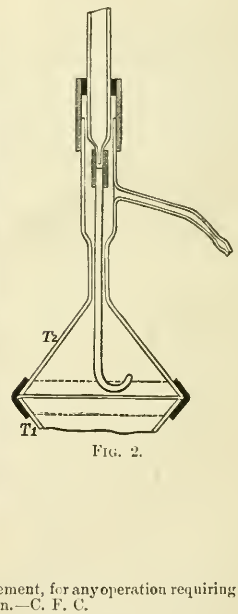


Fig. 2.

New Reaction of Titanic Acid. R. Fresenius Zeit. Anal. Chem. 1885, 410—412.

Solution of titanic acid in hydrochloric or sulphuric acid give with hyposulphurous acid—such as is obtained by the action of zinc upon sulphurous acid—a red coloration, soon passing into yellow. The coloration is striking, with solutions containing 1·5 titanic acid per 1000. With smaller quantities the column of liquid under observation must be correspondingly increased. Inversely, of course, titanic acid may be used to detect the presence of hyposulphurous acid.—C. F. C.

Composition of Commercial Sulphate of Quinine. W. Koppeschaar. Zeit. Anal. Chem. 1885, 362—376.

The stated object of this paper is the strong recommendation by the author of the optical method of examination of commercial alkaloids. The advantages of the method are brought out by the experimental results detailed.

Incidentally the author discusses the cause of the variation in the statements as to the molecular proportion of the water of crystallisation of salts of the alkaloids. He points out that mixtures of alkaloids are in regard to certain properties compound molecules, the properties of which are not the mean of those of the constituents. Quinine sulphates he regards as crystallising with 8 mols. H_2O.—C. F. C.

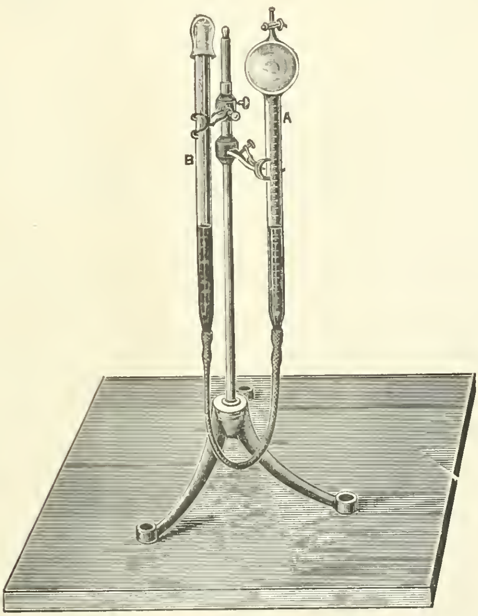
An Apparatus for Rapid Reduction of Gas-volumes to the Normal Pressure and Temperature. C. Winkler. Ber. **18**, 2533—2535.

Two tubes A and B are connected together below by strong indiarubber tubing; B is simply a levelling tube, while A serves as the measuring tube, and is provided with a bulb and tightly-fitting stop-cock above. The tubular portion of A is carefully graduated in cubic centimetres, so that volumes from 95cc. to 125cc. (reckoned from the stop-cock downwards) can be read off to within one-tenth. These limits correspond to the volumes which 100cc. of air, measured at normal pressure and temperature, and saturated with aqueous vapour, would occupy at 800mm. and 0°C., and 700mm. and 30°C. respectively, so that the graduation is sufficiently extensive for all ordinary conditions. The apparatus is regulated once for all, by introducing into the measuring tube 100cc. of moist air, measured at N.P.T. This is best done as follows: A convenient quantity of mercury is poured into the tubes, a few drops of water are allowed to trickle down into A, and then the barometric pressure and the temperature are very carefully determined. By means of the formula—

$$V = \frac{(760 - 4{\cdot}5) \times 100 \times (273 \times t)}{273 \times (B - t)}$$

the volume is calculated which 100cc. of moist air, measured at N.P.T., would occupy under the same circumstances. The stop-cock is opened, and by raising or lowering the levelling tube B, the level of the mercury in A is altered until the calculated volume is enclosed; the stop-cock is then shut. Now the volume of the enclosed air will increase or diminish with the variations of atmospheric pressure and temperature, in the same ratio as the volume of any quantity of gas whose normal volume we wish to determine; so that if the latter be placed in the same room as the apparatus, and if B be raised or lowered until the mercury stands at the same height in both tubes (the stop-cock being always closed), the normal volume of the gas under investigation can easily be found by a simple proportion.

The apparatus is made by Franz Hugershoff, Leipsic. —D. E. J.



A Combined Exhaustion and Compression Apparatus. A. Gawalovski. Chem. Centr. Blatt. **16**, 465—467.

The apparatus is shown complete in Figs. 2 and 8, and in Figs. 1 and 7 in section (p. 758). The two balloons are of glass and are connected by a metal fastening; the tubes A and E are for the entrance and egress of the air as shown by the arrows, and in the larger form (Fig. 2) serve also as an axle by which the apparatus may easily be reversed. Figs. 3 and 6 show different methods for opening and shutting the two tubes; those parts which are made of caoutchouc having the dotted shading. The automatic action of this apparatus, at once an exhaust or pressure pump, is brought about by an arrangement of automatic valves in the suction-tube B, and in the exit-pipe for the water D. For valves the arrangements Figs. 1, 3, 4, 5 and 6 are recommended for choice. Fig. 4 represents a valve consisting of a massive metal bell, or one covered with indiarubber, which sits in a caoutchouc ring and perfectly fits it. The narrowed part of the tube above the ball has a waved outline (see section Fig. 4a) so that air communication is established at *m*, *n* and *o*. However, by affixing the air-communication tubes (Fig. 5) this object is also attained.

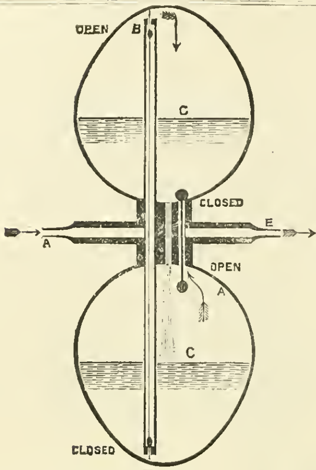


FIG. 1.

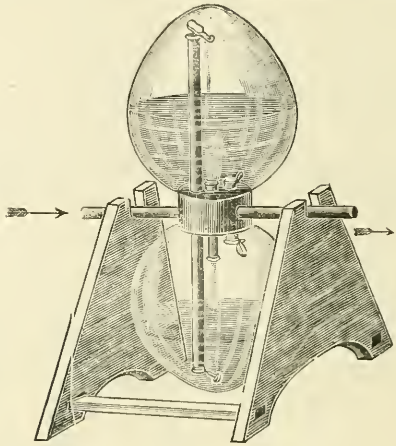


FIG. 2.

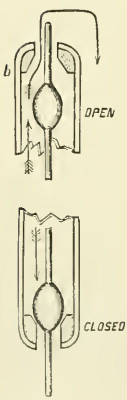


FIG. 3.

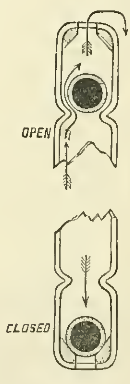
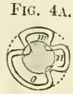


FIG. 4.

FIG. 4A.



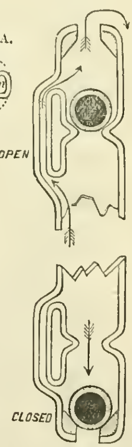


FIG. 5.

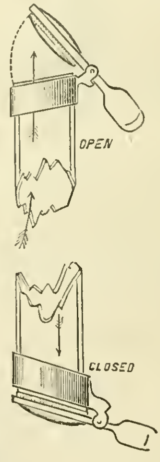


FIG. 6.

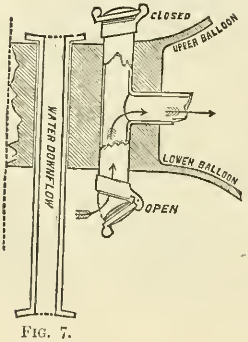


FIG. 7.

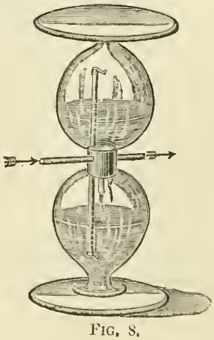


FIG. 8.

The construction shown in Figs. 6 and 7 is based on the use of clapper-valves lined with caoutchouc (see Fig. 7). The apparatus can also be made to serve as a gas-holder.

The small apparatus (Fig. 8) can be recommended for exhaustion or pressure in the case of chemical analyses, whilst the larger one (Fig. 2) does good service for increasing the pressure of illuminating gas, and as an air pump, the use of water service-pipes not being needed.—S. R.

Analysis of Platinum Ores. Th. Wilm. Ber. **18**, 2536-2551.

The author discusses in a long and interesting paper the various methods proposed for the quantitative estimation of platinum, its separation from the other platinum metals and the separation of the whole of these metals from the base metals Fe, Cu, and Ni, occurring in the ores. The method proposed by Claus—viz., the reduction of the higher chlorides to subchlorides by boiling with NaOH solution and precipitation with NH_4Cl, whereby platinic double chloride alone is precipitated—is not here applicable, as the action of caustic soda has only been studied to a limited extent. According to Rose, the action of Na_2CO_3 Na_2HPO_4 and $BaCO_3$ would precipitate rhodium completely, together with a little palladium. The action of mass as illustrated by a mixture of the metals gives totally different results.

1	2	3	4	5	6	7	8
Precipitated with NH_4Cl	After treatment with Na_2CO_3	After treatment with Na_2HPO_4	After treatment with $BaCO_3$	Precipitated with H_2S	After fusion with Na_2CO_3	After treatment with NaOH and NH_4Cl	After treatment with $BaCO_3$ in hot solution.
78·91	77·12	77·24	77·62	76·82	76·71	71·78	54·61
78·51	77·57		77·11	—	76·81	—	—
—	—	—	77·08	—	76·42	—	—

The experiments and results may be briefly stated as follows:—In the first place the ore was dissolved in aqua regia, and the solution filtered from osmiridium and gangue. One portion of the solution was precipitated with NH_4Cl, and the double chlorides weighed, a second was previously treated with Na_2CO_3, a third with Na_2HPO_4, a fourth with $BaCO_3$, and the platinum metals determined in the filtrate. A fifth portion was precipitated with H_2S, and the sulphides digested with nitric acid to dissolve out the Cu. In a sixth portion of the solution, the filtrate from the carbonate or phosphate of soda was evaporated to dryness and fused with carbonate of soda in order to reduce the platinum compounds to the metallic state. The seventh process consisted in heating the chlorides with NaOH solution, whereby a portion of the salts is reduced to subchlorides and not precipitated with NH_4Cl. Experiment No. 8 proves (Rose's statement being incorrect) that $BaCO_3$ precipitates in a hot solution considerable quantities of the platinum metals. The results are given in the above table.

In every case a complete separation of iron and copper was found impossible. Another method with an equally unsuccessful result consisted in precipitating the solution of the ore with iron and extracting the precipitate with aqua regia. In spite of their solubilities, palladium, platinum, gold, and also iron, copper, and traces of nickel remain undissolved.

It is a remarkable fact that by the action of H_2S on an acid solution of the ore, iron is invariably precipitated, and neither this metal nor copper can be extracted with nitric acid.

On digesting the sulphides with yellow ammonium sulphide, PdS dissolves most readily, and at the same time CuS to an extent never observed in the presence of any other metal than Pd.

The author has also tried the method of electrolysis, and finds that with the Pt metals, Cu and Fe are deposited both in HCl and HNO_3 solution. These results appear to point to the conclusion that Fe and Cu are not present in the ores as mixtures; but form a much closer combination. Interesting facts respecting the separation of the Pt metals from one another are given, but do not admit of useful abstraction.—J. B. C.

New Books.

The Dyeing of Textile Fabrics. By J. J. Hummel, F.C.S., Professor and Director of the Dyeing Department of the Yorkshire College, Leeds. Cassell & Co. Limited: London, Paris, New York, and Melbourne. 1885.

Octavo volume bound in cloth, price 5s.; containing Preface by the author, Table of Contents, List of Illustrations (97 in all) and 527 pages of subject matter. An Alphabetical Index concludes the work. The first 43 pages of the work contain matter treating in a very clear, as well as concise manner, of the various textile fibres:—I. Cotton. II. Flax, Jute and China Grass. III. Wool. IV. Silk.

Next follows a chapter on The Operations Preliminary to Dyeing—viz., V. Cotton Bleaching. VI. Linen Bleaching. VII. Wool Scouring and Bleaching. VIII. Silk Scouring and Bleaching. The important subject of Water in its Application to Dyeing, then comes under consideration, with certain of the various methods proposed for purifying it. The Theories of Dyeing are treated of in Chapter X., and the Use of Mordants in Chapter XI., introducing the reader to the Methods and Machinery used in Dyeing described in Chapter XII.

Chapters XIII. to XV. are devoted to the Application of the Natural Colouring Matters, and those furnishing blue, red and yellow tints are specially considered. Chapters XVI. to XXI. deal with the Application of the Artificial Colouring Matters; Chapter XXII., treating of the Application of the Mineral Colouring Matters. The Dyeing of Mixed Fabrics (Cotton and Wool) is the subject of Chapter XXIII. An exceedingly interesting and useful Chapter for the teacher of Practical Dyeing, as well as for the student, is Chapter XXIV., on the Method of Devising Experiments in Dyeing. Chapter XXV., Estimation of the Value of Colouring Matters, and Chapter XXVI., The Detection of Colours on Dyed Fabrics, with the valuable Tables of Colour Tests, will be of great service.

The truly scientific spirit in which the whole work is written very greatly commends this excellent little work to students of Applied Chemistry, as well as to chemists in dye- and print-works' laboratories.

Monthly Patent List.

ENGLISH APPLICATIONS.

1885.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

14033 J. Lee, Halifax. Improvements in the construction of the flues of steam boilers for the consumption of smoke. November 17

14045 W. R. Lake, London—Communicated by J. H. Blessing, United States. An improved method of and apparatus for preventing incrustation in steam boilers. Complete specification. November 17

14142 F. Siemens, London. A method of lining furnaces. November 18

14618 J. Powell and L. Roberts, London. Improvements in open hearth regenerative furnaces. November 28

14708 J. Templer, London. Improvements in surface condensers. November 30

14883 J. K. Broadbent, Salford. An apparatus for introducing calcined steam, and improving the combustion of steam boiler furnaces. December 4

15120 P. E. C. Stromeyer, London. Distilling fluids—viz., "An improved distilling apparatus." December 9

15146 J. Kirkaldy, London. Improvements in condensers and distillers. December 9

15252 P. M. Justice, London—Communicated by C. Dietzsch, Germany. Improved process of and furnaces for burning limestone or lime and similar materials. Complete specification. December 11

15439 E. Fontenilles, Paris. Apparatus for evaporating and concentrating liquids generally. December 16

15482 J. Settle, Manchester. Improvements in furnaces. December 17

II.—FUEL, GAS, AND LIGHT.

14218 T. Charlton and C. S. Wright, Barnsley, and J. Wright, London. Improvements in the method of carburetting or charging atmospheric air, or gases or vapours, or combinations of these, with petroleum, naphtha, or other such hydrocarbon liquids, preparatory to using them either for producing motive power by explosion, or the generation of heat, or as illuminants by slower burning. November 20

14269 P. Tarbutt, London. Method of effecting combustion of liquid fuel. November 21

14283 E. Edwards, London—Communicated by C. F. Sébille and A. Colard, France. Improvements in artificial fuel. November 21

14336 B. Redwood, London. Improvements in measuring and delineating the flame of a lamp. November 23

14392 T. S. Dobson and A. Murfet, London. Improvements in heating and supplying air to assist combustion and consume smoke in steam boiler and other furnaces having firebars, and in apparatus therefor. November 24

14599 J. K. Jones, London. Improvements in ovens for making breeze and coke. November 27

14720 H. Simon, London. An improvement in the manufacture of coke. December 1

14771 S. Kocherthaler, London. Improvements in apparatus for regulating the supply of heat for heating rooms, and for similar purposes. December 1

14859 J. S. Saltery, London. Improvements in the manufacture of artificial fuel. December 3

14865 J. Neil, Glasgow. Improvements in or connected with the burning of hydrocarbon or mineral oils, and other such liquid fuel in steam boiler and other furnaces, and in apparatus therefor. December 3

15104 D. R. Gardner, Glasgow. Increasing the illuminating power of gas. Complete specification. December 9

15181 Leo Kumberg, London. A pneumatic hydrocarbon illuminating apparatus. Complete specification. Dec. 10

15201 A. W. Clark, Glasgow. Improvements in gas lamps. December 11

15286 C. A. von Welsbach, London. Manufacture of an illuminant appliance for gas and other burners. December 12

15291 J. B. Butterfield, Halifax. An improved treatment of furnace gases for drying and heating purposes. December 12

15331 A. Kinnear and E. Fahrig, London. An improved apparatus for carburetting and increasing the illuminating power of gas. December 14

15419 A. Gutensohn, London. Improvements in obtaining gas from hydrocarbons. December 16

15470 C. Blagburn, London. Improvements in apparatus for burning liquid fuel in furnaces, specially applicable to the furnaces of marine boilers. December 16

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

11934 J. C. Hamilton, Glasgow. Improved apparatus for the distillation of shale and other nitrogenous and bituminous substances. December 5

IV.—COLOURING MATTERS AND DYES.

14232 E. Elsaesser, London. Improvements in the manufacture of azo-dyestuffs or colouring matters. Complete specification. November 20

14424 J. Y. Johnson, London—Communicated by the Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of azo dyes. November 24

14802 A. L. Hughes, J. Bartley, and F. Best. Improvements in laundry blue. Complete specification. December 2

14962 H. H. Lake, London—Communicated by A. Leonhardt & Co., Germany. Improvements in the manufacture of colouring matters. December 5

15296 P. Jensen, London—Communicated by the Actien-Gesellschaft fur Anilin-fabrikation, Germany. Process for the production of mixed azo colours. December 12

15337 H. Hassencamp and The Farbenfabriken vorm. Bayer & Co., London. Improvements in the manufacture of colouring matters for dyeing and printing. December 14

15381 J. Y. Johnson, London—Communicated by F. von Heyden Nachfolder, Germany. Improvements in the production of azo dyes. Dec. 15

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

15391 M. E. Cohn, London. A process for treating vegetable spinning fibres. Complete specification. December 15

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

14031 R. H. Ainsworth and E. B. Manby, London. Improvements in the construction of apparatus for scouring, washing dyeing, and other analogous purposes. November 17

14637 J. C. Mewburn, London—Communicated by La Société Leblois, Piceni, et Cie., France. Improvements in bleaching cotton, and in apparatus therefor. November 28

15438 G. Watson, jun., Glasgow. An improved method of obtaining baths of chloride of antimony for use in dyeing and calico printing. December 16

VII.—ACIDS, ALKALIS, AND SALTS.

14027 A. P. Laurie, London. Improvements in the manufacture of soda. November 17

14120 W. Thomlinson and D. Crawford, London. A new or improved process for the separation of phosphorus from "basic process" slags, or other materials containing phosphorus, and for the subsequent treatment thereof to convert the phosphorus into phosphates. November 18

14123 D. Maher, Liverpool. Improvements in lids applicable for caustic drums and other like articles. November 18

14279 G. H Bolton and J. Leathwood, Liverpool. Improvements in lids applicable to caustic soda drum heads and to other purposes. November 21

14364 E. W. Parnell and J. Simpson, Liverpool. Improvements in the manufacture or production of sulphur and sulphuric acid. November 21

14365 J. Simpson and E. W. Parnell, Liverpool. Improvements in the manufacture of bicarbonate of soda. November 21

14526 M. Wolff, Liverpool. Improvements in or appertaining to the manufacture of table salt. November 26

14531 J. Lea, London. Improved method of operating upon zinc ore, and the production of chloride of lime from such treatment. November 26

14629 C. Wigg, Liverpool. Improvements in the treatment of alkaline liquors. November 28

14780 L. E. L. J. B. Régi and L. M. C. Folie-Desjardins, Paris. Process and apparatus for the manufacture of sulphuret of carbon. Complete specification. December 2

VIII.—GLASS, POTTERY, AND EARTHENWARE.

14127 M. F. C. A. Oppermann, London. An improved mode of producing window glass, and apparatus to be used therewith. November 18

14159 G. Johnson and J. Lockwood, Glasgow. Improvements in the construction of china or other tiles for fastening purposes. November 19

14161 J. Howie, Glasgow. Improvements in the manufacture of glazed or enamelled clay goods or ware. November 19

14225 B. J. B. Mills, London—Communicated by P. A. Mignot, France. Improvements in the manufacture of ceramic pastes or bodies, to be used principally in the production of fancy articles in porcelain. November 20

14273 J. Rogers, London. Improvements in the apparatus for drying China clay or similar substances. November 21

14462 J. M. Beuzel, London. Improvements in the manufacture of articles of glass, porcelain, earthenware, and the like. November 25

14468 T. Bolas, Chiswick. Decorating or imprinting devices upon glass, metal, stone, pottery, enamel, asbestos slabs or sheets, or other materials which will withstand the action of fire. November 25

14573 D. Rylands, Stairfoot, Yorkshire. Improvements in means for moulding or pressing glass. November 27

11628 W. H. Hales, Birmingham. Improvements in machinery for moulding pottery-ware. Complete specification. November 28

11947 A. E. Muller, London. Process for the production of rubbing or igniting surfaces on porcelain and other earthenware and stoneware. December 5

15118 H. Hill, Nottingham. An improvement in the manufacture of earthenware used for domestic purposes. December 10

15329 A. J. Boult, London—Communicated by A. Schierholz, Germany. Improvements in the manufacture of ceramic ware. December 11

15477 A. Wilkinson, London. Improved method of operating on glass for producing ornamental effects on or in the surface thereof. December 16

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

14061 H. Mathey, London. Improvements in manufacture of cement and lime. Complete specification. November 17

11065 E. Robbins, London. A new or improved tesseræ or mosaic material for building and other purposes. November 17

14553 W. Brierley, Halifax—Communicated by F. G. Kohlmann, Germany. Improvements in the manufacture of bricks and tiles. November 27

14559 R. B. Lee and J. Hodgson, Manchester. Improvements in the construction of fire-proof pillars and columns. November 27

14710 L. A. Groth, London—Communicated by A. Mark, Germany. A new or improved method of making gypsum boards for preparing rooms instantly in a dry condition. December 1

14725 R. B. Lee and J. Hodgson, Manchester. Improvements in the manufacture of concrete slabs, blocks, pipes, and other articles and parts. December 1

14726 R. B. Lee and J. Hodgson, Manchester. Improvements in the manufacture of concrete fire-proof building materials and parts of buildings, safes, strong-rooms, and other analogous fire-proof structures and receptacles. December 1

14815 L. White, London. Improvements in the manufacture of Portland cement. December 2

11881 A. E. Carey and A. J. Jack, Liverpool. Improvements in the manufacture of Portland cement. December 1

15364 E. G. Colton, London—Communicated by F. Frenzel, United States. Improvements in the manufacture of encaustic tiles. December 15

15128 G. Chapman, Glasgow. Manufacturing a cement suitable for lining steel and other furnaces, or for being made into bricks with which steel and other furnaces could be lined. December 16

15519 H. Bonnycastle and T. M. R. Jones, Lee. An improvement in the manufacture of refractory and non-conducting bricks, blocks, tiles, slabs, and pipes. December 17

X.—METALLURGY, MINING, ETC.

11053 H. E. Newton, London—Communicated by A. Nobel, France. An improved mode of disintegrating rock by heat. November 17

11068 D. Edwards and R. Lewes, London. Improvements in coating metal plates with tin or other metal. November 17

11136 J. Lewthwaite, London. An improved method of producing malleable castings. November 18

11142 F. Siemens, London. A method of lining furnaces. November 18

11143 F. Siemens, London. Regenerative gas furnace for continuous reduction of iron ore. November 18

11193 W. F. Richards, London. Improvements in the production of aluminium. November 19

14212 E. Morewood, London. Improvements in coating sheets, plates, and other pieces of metal. November 20

11276 W. E. Everitt, London. Improvements in casting hollow metallic ingots for the manufacture of metallic tubes, and in moulds for casting the said hollow ingots. November 21

14325 R. Grätzel, London. Improvements in the production of aluminium and aluminium-bronze. November 23

11368 C. Hargrove, Olton. A new and improved method of producing aluminium and its alloys. November 21

11411 R. Heathfield, London. An improvement or improvements in utilising waste products obtained in galvanising iron. November 24

11636 L. J. O. Monchel, London. The manufacture of magnesium bronze. November 28

11736 W. Scott, Wandsworth. Improvements in blast-furnaces. December 1

11921 W. P. Thompson, Liverpool—Communicated by C. Husgafvel, Russia. Improvements in producing malleable iron or steel direct from the ore, and apparatus therefor. Complete specification. December 5

15062 M. H. Hurrell and E. Easton, London. Improvements in the apparatus to be used in the treatment of ores and refuse metals. December 8

15170 J. D. Grey, London. Improvements in the method of rolling steel and iron bars or plates for the manufacture of tin and terne plates. December 10

15239 M. H. Hurrell and E. Easton, London. Improvements in the treatment of ores, and in apparatus to be used therefor. December 11

15294 A. J. Boult, London—Communicated by T. S. Sohne, Germany. Improvements in the coating of hardware. December 12

15357 S. Thomas, Newport, Mon. Improvement in coating tin plates. December 15

XI.—FATS, OILS, AND SOAP MANUFACTURE.

11380 R. Ross, Pudsey. Improvements in the manufacture of soap for toilet and cleansing purposes. November 21

11699 E. Mansfield and A. P. Rivolta, London. Process and apparatus for removing oil, fat, and other foreign matter from cotton waste, wool, silk, rags, oil-cloth, and other fibrous material. November 30

14957 C. D. Abel, London—Communicated by the Fabrik Chemischer Produkte Actien Gesellschaft, Germany. Improvements in the separation and treatment of fatty matter from compounds containing wool fat. December 5

XII.—PAINTS, VARNISHES, AND RESINS.

11128 J. B. Spence, London. Improvements in the preparation of materials to be used in making paint. November 18

14663 E. J. Digby, London. Making black lead. November 30

15131 A. McLean and R. Smith, London. Improvements in the preparation of coloured varnishes. December 9

15135 A. McLean and R. Smith, London. Improvements in the manufacture of pigments. December 9

15231 J. Blenkinsop, London. An insulating medium for protecting iron and steel ships' plates and other submerged surfaces of iron and steel from the corrosive or electro-galvanic action set up between the iron or steel plates and materials used in anti-fouling compositions. December 11

15454 R. Wright and C. Wright, London. The royal patent liquid stove polish. December 16

15471 C. D. Abel, London—Communicated by E. Schaal, Germany. An improved manufacture of turpentine from the resins of conifers. Complete specification. December 16

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

11351 S. F. Upington and W. J. Goulborne, London. Improvements in leather compositions made with waste leather for various useful purposes and objects. November 23

11414 E. Edwards, London—Communicated by C. Rollen-Corneille, France. Improvements in the process of and apparatus for tanning leather. November 21

15226 J. Turrell, London. Improvements in grounding machines or apparatus for fleshing, paring, and stoning chamois, kid, and other leathers. December 17

XIV.—AGRICULTURE, MANURES, ETC.

11151 J. B. Spence, London. Improvements in the manufacture of fish manure. November 25

11159 H. Hencke, J. Palm, and E. Seelig, London. Improvements in the method of and apparatus for making fodder from certain waste products. November 25

XV.—SUGAR, STARCHES, GUMS, ETC.

14067 J. Richmond and W. Whiting, London. Improvements in and connected with machinery for sawing and cubing loaf sugar. November 17

14175 J. G. Chapman, London. Improvements in and relating to sugar cane mills. November 19

15530 L. Sternberg, London. An improved process for extracting sugar from saccharine fluids. Complete specification December 17

XVI.—BREWING, WINES, SPIRITS, ETC.

11425 J. Hodson, London. Improvements in and apparatus for tunning or cleansing beer. November 21

11868 T. P. Chittenden, London. An improved method of aerating and attemperating worts and other liquors, and securing a pure germless atmosphere wherein to carry on fermentation. December 3

15063 A. W. Gillman and S. Spencer, London. Improvements in the manufacture of finings for sour beer, brewers waste, and returns. December 8

15168 F. Keeling, London. Improvements in preparation of finings for clarification of beers and wines. December 10

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

(A) *CHEMISTRY OF FOODS.*

14233 J. E. Taylor—Communicated by W. Peacock, Australia. Improvements in the preservation of fruit. November 20.

14552 B. H. Thwaite, Liverpool. Improvements in method of preserving animal and vegetable food and liquids. November 27

11661 J. Sharman, Sheffield. A new and improved means and method of cleansing and preserving English and foreign fruits. November 30

11697 H. Pischon, London. Improved treatment of alimentary substances for their preservation, and apparatus for that purpose. November 30

15387 J. Hooker, London. Improvements in the preservation of condensed milk, and of milk either condensed or in the natural state, in admixture with other alimentary matters and medicinal matters or mixtures, or preparations of such matters. December 15

(B) *SANITARY CHEMISTRY.*

11322 J. B. Scammell, London. Improvements in the methods of filtering water for drinking and other purposes. November 23

11372 A Bell, Manchester. Improvements in apparatus for use in softening or purifying water. November 24

11390 F. R. Lipscombe, London. An apparatus for the softening and purifying of water. November 24

11807 W. F. B. Massey-Mainwaring and J. Edmunds, London. Improvements in arrangements for use in oxygenating water contaminated with organic matter. December 2

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11670 F. M. Hill, New York. A chemical safety paper for cheques, bills of exchange, draughts, and legal documents. November 30

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